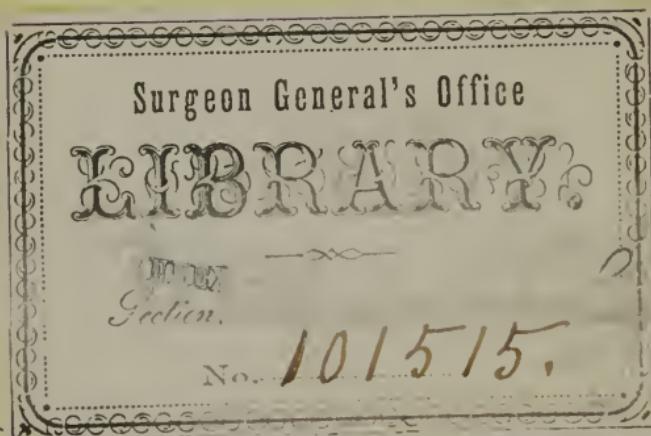
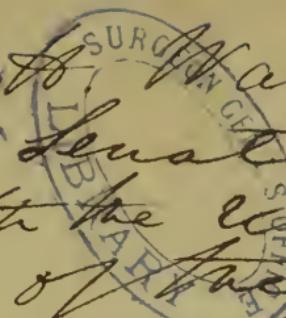


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Scientific and Medical  
Books, and all objects  
of Natural History  
**A. E. FOOTE, M. D.**  
1223 Belmont Ave.,  
Philadelphia, Pa.



Hon C. W. Warren  
Mass. Senate.  
With the respects  
of the  
Author.





# EXAMINATIONS

OF

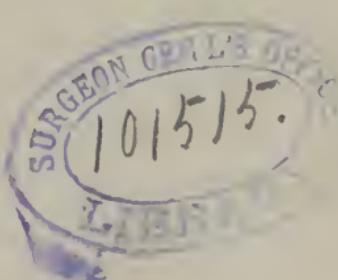
DRUGS, MEDICINES, CHEMICALS, &c.,

AS TO THEIR

PURITY AND ADULTERATIONS.

By C. H. PEIRCE, M. D. 

TRANSLATOR OF STÜCKHARDT'S PRINCIPLES OF CHEMISTRY, AND EXAMINER OF  
MEDICINES, ETC. FOR THE PORT OF BOSTON.



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M E T C A L F   A N D   C O M P A N Y ,  
P R I N T E R S   T O   T H E   U N I V E R S I T Y .

## P R E F A C E.

---

THE important subject of the adulteration of medicines is now attracting considerable attention in this country. By an act of Congress, passed a few years since, *examiners* were appointed for the principal ports of the country, to examine all medicines imported from foreign countries, and to reject such as were found to be unfit for medicinal purposes, or such as were not duly labelled, when so required.

This act was passed from the conviction that many adulterated and spurious medicines were imported from abroad, and that the American market was a receptacle for all such vile impositions. It has exerted a most beneficial influence, not only by causing the *rejection* of such spurious medicines, but by preventing the *importation* of them from foreign countries. Few persons abroad will encounter the risk of exporting to this country fraudulent medicines, when they are aware of the strict

examination such medicines must undergo here, with the certainty that they will be condemned if found to be spurious, or below the appointed standard of purity.

This act of Congress has not only been *directly* beneficial in preventing the importation of fraudulent medicines, but it has exerted a great and good influence, by directing the attention of the people to the subject of the adulteration of medicines. On being made aware of the extent to which this is carried on, they will be cautious of whom they purchase, and will thus *indirectly* help in carrying out the provisions of the law.

Let it also be remembered, that adulterated medicines not only enter our market from *abroad*, but are manufactured here; though the general government prevents the entrance of false medicines into the country in a great degree, yet it has no power to prevent home adulteration. This can only be prevented by State or municipal legislation, and it is to be hoped that the separate States, cities, and towns will coöperate with the general government, by some judicious enactments, in preventing the nefarious and cruel practice of adulterating and falsifying medicines.

I have not had an opportunity of investigating the action of the different European nations on

this subject, but I have been informed that in Germany very stringent laws exist, which effectually prevent the traffic in spurious medicines.

In the following work I have not only given the methods of testing the purity and adulterations of *medicines*, but also of *drugs* in general, and of *chemicals* and some articles of *food*. Each subject is almost a branch of the other, and a work of this sort which neglected to combine the whole would seem imperfect. Some articles, which should have been considered, may have been overlooked; and it is almost impossible that such should not be the case.

I have called to my aid in this work my friend, Dr. C. Linck, a graduate of the Giessen laboratory, and formerly assistant to Professor Horsford in the Chemical Department of the Lawrence Scientific School. This accurate and critical chemist has been kind enough, not only to make additions to some of my chemical articles, for which his name is quoted, but also to furnish me with many original articles, such as those on *alcoholic liquors*, *water*, *acidimetry*, *alkalimetry*, *chlorimetry*, *quinine*, *salts of tin*, *valerianates*, *ultramarine*, and *ether*. I am requested by him to state, that he wishes to be considered solely responsible for the articles which he has written; but I must be permitted to say,

that whatever he has written is in consonance with my own opinions, and on this ground alone could I have admitted his contributions into my treatise.

In writing the present work I have endeavored to make it practical, simple, and concise. In the latter respect I may have erred, and left too much unsaid; but certainly no error is more pardonable than this in a work intended as a *manual* or *hand-book*.

C. H. PEIRCE.

CAMBRIDGE, March 1, 1852.

# I N D E X.

Acid, acetic, 1, 5.  
" arsenious, 43.  
" benzoic, 50.  
" boracic, 55.  
" carthamic, 198.  
" citric, 77.  
" gallic, 96.  
" hydrocyanic, 189.  
" hydrosulphuric, 118.  
" muriatic, 105.  
" nitric, 158.  
" nitro-muriatic, 159.  
" oxalic, 167.  
" phosphoric, 171.  
" pyroligneous, 1.  
" succinic, 225.  
" sulpharsenious, 44.  
" sulphindigotic, 227.  
" sulphuric, 229.  
" tannic, 232.  
" tartaric, 233.

Acidimetry, 41.

Aconitine, 9.

Alcohol, 10.  
" anhydric, 95.

Alcoholic liquors, 11.

Alkalimetry, 20.

Alkanet, 24.

Aloes, 23.

Alum, 24.

Amber, 26.

Ambergris, 27.

Ambrein, 27.

Ammonia, 28.  
" carbonate of, 30.  
" chloro-aurate of, 100.  
" muriate of, 33.  
" succinate of, 31.

Ammoniac, 32.

Ammonium, chloride of, 33.  
" sulphide of, 31, 119, 260.

Amyl, hydrated oxide of, 95.

Angustura, 34.

Annotto, 35.

Antichlorine, 218.

Antimony, 36, 40.  
" crude, 40.  
" golden sulphuret of, 40.  
" oxide of, 37.  
" oxysulphuret of, 40, 41.  
" pentasulphuret of, 41.  
" potassio-tartrate of, 38.  
" precipitated sulphuret of, 40.  
" sesquioxide of, 37.  
" sulphuret of, 40.

Aqua-fortis, 158.

Aqua-regia, 159.

Archil, 41.  
" powdered, 89.

Argol, 77.

Aricine, 73.

Arrow-root, 42.

Arsenic, 43.  
" Runge's test for, 16.  
" yellow sulphuret of, 44.

Ashes, 45.

Assafœtida, 45.

Baker's salt, 30.

Balsam of copaiba, 83.  
" Peru, 47.  
" Tolu, 47.

Barilla, British, 121.

Barium, chloride of, 48.

Baryta, carbonate of, 48.  
" muriate of, 48.

Baryta, nitrate of, 49.  
     " sulphate of, 49.  
 Barytes, 49.  
 Beer, 11, 17.  
 Benzoin, 50.  
     " flowers of, 50.  
 Berries, French, 250.  
     " Persian, 250.  
     " yellow, 250.  
 Bismuth, 52.  
     " magistery of, 53.  
     " subnitrate of, 53.  
 Bitter-apple, 81.  
 Black lead, 54.  
 Bleach crystals, 218.  
 Bleaching powder, 66, 132.  
 Blue, azure, 205.  
     " Berlin, 112.  
     " cobalt, 205.  
     " Paris, 112.  
     " Prussian, 112.  
     " Thenard, 205.  
     " Turnbull's, 113, 187.  
 Blue powder, 205.  
 Blue stone, 187.  
 Bone-ashes, 133.  
 Bone-black, 55.  
 Borax, 213.  
 Brandy, 11.  
 Braziletto-wood, 56.  
 Brazil-wood, 56.  
 Bread, 56.  
 Brimstone, 227.  
 Bromine, 58.  
 Calcium, chloride of, 59.  
 Calomel, 148.  
 Calysaya bark, 72, 75.  
 Camphor, 60.  
 Canella bark, 60.  
 Cantharides, 61.  
 Carmine, 61.  
 Carthagena bark, 72, 76.  
 Carthamine, 198.  
 Cassia, 76.  
     " buds, 77.  
 Castor, 62.  
 Catechu, 63.  
 Celestine, 225.  
 Ceruse, 125.  
 Chalk, prepared, 131.  
 Charcoal, animal, 66.  
 Charquedilla bark, 75.  
 Cheese, 66.  
 Chillies, 65.  
 Chlorimetry, 66.  
 Chloroform, 71.  
 Chrome green, 72.  
     " yellow, 127.  
 Cinchona, 72.  
 Cinchonine, 73.  
 Cinnabar, 150.  
 Cinnamon, 76.  
 Cloves, 77.  
 Cobalt, oxide of, 78.  
 Cochineal, 79.  
 Colchicum, 81.  
 Colcothar, 116.  
 Collodion, 81.  
 Colocynth, 81.  
 Colombo, 82.  
 Colophony, 197.  
 Confectionery, 82.  
 Conia, 104.  
 Copal, 26, 84.  
 Copper, acetate of, 85.  
     " sulphate of, 87.  
 Copperas, 117.  
 Corrosive sublimate, 144.  
 Cream of tartar, 177.  
 Creosote, 88.  
 Cubebs, 88.  
 Cudbear, 89.  
 Cutch, 63.  
 Dammar resin, 85.  
 Dextrine, 103.  
 Digitalis, 95.  
 Dragon's blood, 89.  
 Dutch white, 125.  
 Dyers' physic, 233.  
 Elaterin, 89.  
 Elaterium, 89.  
 Elemi, 90.  
 Epsom salts, 137.  
 Ergot, 91.  
 Ether, oenanthic, 12.  
     " sulphuric, 91.  
 Ethiops mineral, 146.  
 Fard's Spanish white, 53.  
 Fernambuco wood, 56.  
 Filtering paper, 169.  
 Flake white, 125.  
 Flaxseed, 93.  
 Flies, Spanish, 61.  
 Flour, 93.

Foxglove, 95.  
 Fustic, 95.

Galbanum, 96.  
 Galls, 97.  
 Gambier, 63.  
 Gamboge, 98.  
 Garancine, 99.  
 Gentian, 99.  
 Glauber's salt, 219.  
 Glycetyl, hydrated oxide of, 100.  
 Glycerine, 100.  
 Gold, chloride of, 100.  
   " cyanide of, 100.  
   " iodide of, 100.  
   " oxide of, 100.  
   " powder of, 100.  
   " preparations of, 100.  
   " and sodium, chloride of, 100.  
 Graduated glasses, to test, 20.  
 Graphite, 54.  
 Gray bark, 72.  
 Green, arsenical copper, 72.  
   " chrome, 72.  
   " copper, 72.  
 Guaiac, 101.  
 Guaiacum wood, 101.  
 Gum Arabic, 102.  
   " artificial, 103.  
   " Benjamin, 50.  
   " British, 103.  
   " copal, 84.  
   " Senegal, 102.  
   " substitute, 103.  
   " tragacanth, 103.  
 Gypsum, 133.

Hamburg white, 125.  
 Hartal, 44.  
 Hartshorn, spirits of, 28.  
 Hemlock, 104.  
 Honey, 104.  
 Hydrometers, testing of, 5, 10.

Indigo, 107.  
   " solution of, 227.  
 Iodine, 110.  
 Ipecacuanha, 111.  
 Iron, ammonio-citrate of, 112.  
   " ammonio-tartrate of, 112.  
   " citrate of, 112.  
   " ferricyanide of, 113.  
   " ferrocyanide of, 112.  
   " hydrated sesquioxide of, 117.

Iron, iodide of, 114.  
   " lactate of, 115.  
   " pills of carbonate of, 115.  
   " powder of, 116.  
   " red oxide of, 116.  
   " sesquioxide of, 116.  
   " subcarbonate of, 117.  
   " sulphate of, 67, 117.  
   " sulphide of, 118.  
   " tartarized, 116.  
   " valerianate of, 237.

Isinglass, 119.

Jalap, 120.  
 Jesuit's bark, 72.

Kali, 172.  
 Kelp, 121.  
 Kermes mineral, 41.  
 King's yellow, 44.  
 Kino, 121.  
 Kreasote, 88.  
 Krems white, 125.

Lac, 121, 152.  
 Lac-dye, 123.  
 Lac-lake, 123.  
 Lapis infernalis, 172, 204.  
   " lazuli, 236.

Lead, acetate of, 124.  
   " black, 54.  
   " carbonate of, 125.  
   " chromate of, 127.  
   " nitrate of, 127.  
   " protoxide of, 128.  
   " red, 129.  
   " semivitrified oxide of, 128.  
   " sugar of, 124.  
   " white, 125.

Lemons, salt of, 176.  
 Lignum vitæ, 101.  
 Linna bark, 76.  
   " wood, 56.

Lime, 130.  
   " carbonate of, 131.  
   " chloride of, 132.  
   " chlorinated, 66, 132.  
   " hypochlorite of, 132.  
   " muriate of, 59.  
   " precipitated phosphate of, 133.  
   " sulphate of, 133.

Linseed, 93.  
 Liquorice, 134.  
 Litharge, 128.

Litmus, 135, 259.  
 Logwood, 56.  
 Loxa bark, 72, 76.  
 Lunar caustic, 204.  
 Madder, 99, 135.  
 Magnesia, 136.  
     " alba, 137.  
     " carbonate of, 137.  
     " calcined, 136.  
     " sulphate of, 137.  
 Manchada bark, 75.  
 Manganese, 139.  
     " black oxide of, 139.  
     " bog, 139.  
     " hydrated peroxide of, 139.  
     " peroxide of, 139.  
     " salts of, 141.  
 Manna, 141.  
 Maracaybo bark, 72, 75.  
 Massicot, 128.  
 Mastic, 142.  
 Meadow saffron, 81.  
 Mercury, 143.  
     " ammoniated, 144.  
     " biniodide of, 145.  
     " bisulphuret of, 150.  
     " black oxide of, 145.  
     "      " sulphuret of, 146.  
     " cyanide of, 147.  
     " green iodide of, 147.  
     " mild chloride of, 148.  
     " muriate of, 144.  
     " nitric oxide of, 147.  
     " oxymuriate of, 144.  
     " peroxide of, 147.  
     " protochloride of, 148.  
     " red iodide of, 145.  
     "      " oxide of, 147.  
     "      " sulphuret of, 150.  
     " subchloride of, 148.  
 Methyl, hydrated oxide of, 191.  
 Milk, 152.  
     " sugar of, 226.  
 Minium, 129.  
 Molasses, 227.  
 Morin, 96.  
 Morphia, 165.  
     " acetate of, 154.  
     " muriate of, 154.  
     " salts of, 154.  
     " sulphate of, 154.  
     " valerianate of, 237.  
 Musk, 156.  
 Myrobalans, 157.  
 Myrrh, 157.  
 Narcotine, 167.  
 Nicaragua wood, 56.  
 Nitre, 182, 217.  
 Nut-galls, 97.  
 Oil, cajeput, 59.  
     " castor, 63, 160.  
     " cod-liver, 80.  
     " fusel, 11, 12, 95.  
     " grain, 11, 12, 95.  
     " lard, 63.  
     " palm, 168.  
     " potato, 95.  
 Oils, essential, 161.  
     " fixed, 159.  
     " sweet principle of, 100.  
     " volatile, 161.  
 Opium, 162.  
 Orchil, 41.  
 Orleana, 35.  
 Orpiment, 44.  
 Pale bark, 72.  
 Pastel, 250.  
 Peach-wood, 56.  
 Pearlash, 181.  
 Pearl-white, 53.  
 Pepper, 178.  
     " Cayenne, 65.  
 Persio, 89.  
 Peruvian bark, 72.  
 Phosphorus, 172.  
 Pills, bluc, 143.  
     " mercurial, 143.  
     " Vallet's, 115.  
 Pinksalt, 234.  
 Piperine, 170.  
 Pitch, Burgundy, 58.  
 Plaster of Paris, 133.  
 Plumbago, 54.  
 Pompholix, 252.  
 Potash, 172, 181.  
 Potashes, 181.  
 Potassa, 172.  
     " acetate of, 173.  
     " alcoholic, 172.  
     " bicarbonate of, 174.  
     " bichromate of, 175.  
     " binoxalate of, 176.  
     " bitartrate of, 177.  
     " carbonate of, 179, 181.

Potassa, chlorate of, 180.  
 " chromate of, 180.  
 " nitrate of, 187.  
 " red prussiate of, 187.  
 " and soda, tartrate of, 184.  
 " solution of, 49.  
 " sulphate of, 184.  
 " tartrate of, 185.  
 " yellow prussiate of, 187.

Potassium, bromide of, 186.  
 " cyanide of, 186.  
 " iodide of, 188.  
 " protoxide of, 172.  
 " sulphocyanide of, 189.

Pounce, 201.

Pounxa, 213.

Purple of Cassius, 101.

Pyrolusite, 139.

Pyroxilic spirit, 191.

Quassia, 192.

Quinine, 73.  
 " sulphate of, 192.  
 " valerianate of, 237.

Ratsbane, 43.

Rcd bark, 72, 76.

Red precipitate, 147.

Rhubarb, 195.

Rochelle salt, 184.

Rocou, 35.

Rosin, 197.

Rouge végétal, 198.

Rye, spurred, 91.

Safflower, 197.

Saffron, 199.

Sagapenum, 200.

Sal ammoniac, 33.

Salteratus, 182.

Salt, common, 219.

Saltpetre, 182, 217.

Sandarach, 201.

Sapan wood, 56.

Sarsaparilla, 201.

Seammony, 201.

Scidlitz salt, 137.

Seignette salt, 184.

Senna, 203.

Shellac, 121.

Silver, cyanide of, 204.  
 " nitrate of, 204.  
 " oxide of, 205.

Smalt, 205.

Smelling-salts, 30.

Soap, 206.

Soda, acetate of, 211.

Soda ash, 215.  
 " borate of, 213.  
 " carbonate of, 212, 214, 216.  
 " crystals, 216.  
 " hyposulphite of, 216.  
 " muriate of, 219.  
 " nitrate of, 217.  
 " phosphate of, 215.  
 " potassium-tartrate of, 184.  
 " salts, 215.  
 " sulphate of, 219.  
 " sulphite of, 218.  
 " tartarized, 184.

Spirit of nitre, 158.  
 " " sweet, 221.  
 " of nitrous ether, 221.  
 " proof, 10.  
 " rectified, 10.  
 " of wine, 10.

Spurred rye, 91.

Starch, 222.

St. Martha wood, 56.

Storax, 223.

Strontia, carbonate of, 223.  
 " nitrate of, 223.  
 " sulphate, 224.

Strychnine, 224.

Sugar, 226.

Sulphur, 227.

Sulphuretted hydrogen, 118, 259.

Sulphuric ether, 91.

Sumac, 232.

Table of spec. grav. of acids, 6.  
 " " " alcohol, 10.  
 " strength of ammonia, 29.

Talc, 136.

Tannin, 232.

Tartar, 177.  
 " emetic, 38.

Tartarized antimony, 38.

Terra japonica, 63.

Test acids, preparation of, 21.

Test, ammonia, 260.  
 " arsenic in presence of antimony, 263.  
 " baryta, 260.  
 " copper, 261.  
 " for animal matter, 264.  
 " " iron, prussiate, 261.  
 " " organic matter, 264.

Test, for vegetable matter, 264.  
 " iodine, 262.  
 " lime, 260.  
 " magnesia, 262.  
 " Marsh's arsenical, 262.  
 " muriatic acid, 261.  
 " nitric acid, 263.  
 " oxalic acid, 260.  
 " phosphoric acid, 263.  
 " potassa, 261.  
 " prussic acid, 190.  
 " silver, 261.  
 " starch, 262.  
 " sulphuric acid, 260.  
 " tartaric acid, 261.  
 Test paper, blue, 135, 259.  
 " " red, 135, 259.  
 " " turmeric, 235, 259.  
 Tests, general, 256.  
 " special, 259.  
 Tin crystals, 234.  
 " muriate of, 235.  
 " oxymuriate of, 233.  
 " perchloride of, 233.  
 " powder of, 234.  
 " protochloride of, 234.  
 " salt of, 234.  
 Tineal, 213.  
 Tragaeanth, 103.  
 Turmeric, 235.  
 Turnsole, 135.  
 Ultramarine, 236.  
 Valerianates, 237.  
 Vareck, 121.  
 Veratrine, 238.  
 Verdigris, 85.  
 Vermilion, 150.  
 Vinegar, 1, 5.  
 Vitriol, blue, 87.  
 " green, 117.  
 " oil of, 229.  
 " white, 253.  
 Volatile alkali, 28.  
 " salts, 30.  
 Wad, 139.  
 Water, 238.  
 Wax, 248.  
 White precipitate, 144.  
 Wine, 11.  
 Winter's bark, 61.  
 Woad, 250.  
 Wood naphtha, 191.  
 " spirit, 191.  
 " yellow, 95.  
 Yellow bark, 72.  
 " berries, 250.  
 " wood, 95.  
 Yellow, King's, 44.  
 Zinc, acetate of, 250.  
 " carbonate of, 251.  
 " muriate of, 252.  
 " oxide of, 252.  
 " sulphate of, 253.  
 " valerianate of, 237.

## ERRATA.

Page 1, line 8, for "acetate of lead, or other acetates," read "acetate of soda and acetate of lead."  
 " 36, " 24, insert "copper" before "iron."  
 " 41, " 22, for "can" read "should."  
 " 56, " 3, omit hyphen between "paper" and "brown."  
 " 70, " 3 from bottom, for "27" read "36."  
 " 86, " 13, after "Verdigris," place "has a strong coppery taste," and omit it in line 15.  
 " 100, " 18, for "chloroacetate" read "chloroaurate."  
 " 102, " 6, omit "according to the appearance it presents."  
 " 254, " 2, for "ammonia" read "ammonium."  
 " 262, " 13, for "iodine" read "iodide."



EXAMINATION  
OF  
DRUGS, MEDICINES, ETC.

---

ACETIC ACID.

SYN. *Vinegar; Pyroligneous Acid; Wood Vinegar; Acetum; Acidum Aceticum.*

*Commercial acetic acid* is obtained principally from acetate of lead, or other acetates, by distillation. When acetic acid is distilled from wood, a product is obtained called *pyroligneous acid*, or *wood vinegar*. And when this acid is made by decomposing alcoholic liquors, as wine, cider, beer, &c., without distillation, it is termed *vinegar*. These three sorts of acetic acid will be treated of as *acetic acid*, *pyroligneous acid*, and *vinegar*.

It is hardly necessary to mention the physical properties of these acids, as they are well known, unless to state that pyroligneous acid has a more or less tarry taste, according to the purification it has undergone.

*Acetic acid*, in its highest degree of concentration, is solid at low temperatures. It melts at 61° Fahrenheit. Its density at 65° F. is 1.063. It has a quick, pungent odor, a very acid taste, and blisters the skin. It boils at 248° F. It mixes in every proportion with water, and the first addition of water renders it more dense. Its maximum of density is 1.079; by adding more water, the density diminishes. From this it will be seen that the hydrometer cannot be easily applied for determining the strength of acetic acid.

Indeed, to test the strength of acetic acid, as also of pyroligneous acid and vinegar, the safest method is to determine how much crystallized bicarbonate of potassa it will neutralize, 100 grains of the latter almost exactly neutralizing 50 grains of anhydrous acetic acid. "Hence a solution of the carbonate, containing 200 grains in 100 measures, will form an acetimeter of the most perfect and convenient kind; for the measures of test liquid expended in saturating any measure — for instance, 1,000 grains — of acid will indicate the number of grains of real acetic acid in that quantity. Thus, should 1,000 grains of acid require 50 measures of the alkaline solution, it would show that the sample contains 50 grains of real acetic acid in 1,000, or 5 per cent." (Modified from Ure.) See *Acidimetry*.

There are many different strengths of acetic acid. The acetic acid of the Edinburgh College contains from 99 to 100 per cent. of real acid; the *glacial acetic acid* of the Dublin College, 99 per cent.; the *strong acetic acid* of the Dublin College, 59 per cent.;

the *English acid of commerce*, 39 per cent.; the *acetic acid of the London College*, 37 per cent.; that of the *United States Pharmacopœia*, 31 per cent.; *pyroligneous acid*, from 25 to 5 per cent.; and *diluted acetic acid*, from 5 to 3 per cent.; and this last is about the strength of *vinegar*.

*Acetic acid* should be perfectly pure. "Pure acetic acid must leave no residue upon evaporation. Sulphuretted hydrogen, and solution of silver and barytes, must not precipitate it when diluted; solution of barytes, not even when the acetic acid has been previously boiled with nitric acid. Indigo solution must not be discolored on being heated with the acid."

But these tests are too delicate to be applied to *pyroligneous acid*, and to *vinegar*, unless we except the sulphuretted hydrogen and indigo tests, the former of which, if it gave a dark precipitate, would indicate the presence of *lead, copper, &c.*, and the latter that of *free nitric acid*.

But *vinegar* is liable to adulteration also with *free sulphuric acid*, *free muriatic acid*, and with *acrid vegetable substances*. The latter are detected by evaporating a sample of the vinegar to the consistency of a syrup, when their presence will be revealed by the taste. The *free muriatic acid* is detected by distilling a portion of the vinegar, and testing the distilled liquor with nitrate of silver; see *Silver Test*. *Free sulphuric acid* is detected by evaporating over a water-bath a portion of the vinegar with sugar, which will be charred, if this acid is present.

Sometimes, also, vinegar is sophisticated with *ni-*

*tric, oxalic, tartaric, and sulphurous acids.* Nitric acid is detected by distilling a portion, and then gently adding to the distillate a solution of protosulphate of iron, which will immediately form a dark-colored line, if it is present. Nitric acid will also destroy the blue color of sulphindigotic acid.

Evaporate a portion of the vinegar to about one half of its volume, and then, if it yields a precipitate with acetate of potassa, tartaric acid is present.

Oxalic acid is so poisonous, that it is almost impossible to suppose that any one would be so reckless as to adulterate vinegar with it; yet it is stated that it has been thus adulterated. It may be detected by neutralizing the vinegar with ammonia, and then adding chloride of calcium, which will form with it a white precipitate of oxalate of lime. Sulphurous acid may be detected by adding an excess of chloride of barium to the vinegar, and then filtering; if the filtrate, on being boiled with nitric acid, gives a precipitate, then sulphurous acid is present.

#### ACIDIMETRY.

ACIDIMETRY is the art of measuring or determining the strength of acids, especially of the liquid acids, containing water. Its application is limited to sulphuric, nitric, muriatic, and acetic acids. For the first three acids, the determination of the specific gravity, by means of the hydrometer, is generally sufficient to show their strength, as indicated by the table appended to this article. But this test cannot

be applied for determining the strength of *concentrated acetic acid*, or of *vinegar*.

Our common hydrometers are, however, very frequently inaccurate and deceptive instruments, and should never be used without being previously tested. This test can be made by dipping the instrument into several liquors of different densities, and then ascertaining, by means of the tables, the specific gravity which corresponds to the number of degrees observed on the hydrometer. Afterwards determine the specific gravity of the same liquids directly and carefully, by means of an accurate chemical balance. In both cases the results should be the same.

As the accurate determination of the specific gravity of these numerous liquids, which it is necessary to make, is not very easy for those who are not skilled in manipulating, and as it presupposes the possession of a very delicate balance, many persons may prefer the following method for correcting their instruments. It consists in simply comparing the amount of acid found by means of the hydrometer with that found by another acidimetical method, which will be described a little further on. Wherever there is a serious disagreement in these results, the hydrometer should be rejected altogether, or the correction should be noted down for reference.

The hydrometer in common use for acidimetry is that of Baumé. The following table indicates the specific gravity corresponding to its degrees.

## ACIDIMETRY.

Deg. B.	Sp. Gr.	Acid Sulph. per ct.	Acid Mur. per ct.	Acid Nitr. per ct.	Deg. B.	Sp. Gr.	Acid Sulph. per ct.	Acid Mur. per ct.	Acid Nitr. per ct.
1	1.0070	1.00	2.00	1.25	35	1.3190	42.25		54.25
2	1.0141	2.00	3.00	2.50	36	1.3311	43.70		56.75
3	1.0213	3.00	4.25	4.00	37	1.3434	45.00		59.25
4	1.0286	4.25	6.00	5.10	38	1.3559	46.50		61.60
5	1.0360	5.25	7.75	6.50	39	1.3686	47.80		64.10
6	1.0435	6.25	10.00	8.15	40	1.3815	49.50		66.75
7	1.0511	7.75	10.50	9.80	41	1.3947	50.75		69.10
8	1.0588	8.50	12.00	10.50	42	1.4082	52.10		72.25
9	1.0666	9.50	14.00	12.25	43	1.4219	53.25		76.00
10	1.0745	11.00	16.00	13.75	44	1.4359	55.00		79.50
11	1.0825	12.20	17.00	15.00	45	1.4501	56.50		83.00
12	1.0906	13.25	18.50	16.75	46	1.4645	57.80		87.25
13	1.0988	14.50	20.00	17.75	47	1.4792	59.25		92.00
14	1.1071	15.75	20.50	19.25	48	1.4942	60.75		97.25
15	1.1155	16.90	23.00	20.60	49	1.5096	62.25		
16	1.1240	18.00	25.20	22.25	50	1.5253	63.75		
17	1.1326	19.00	26.75	23.75	51	1.5413	65.25		
18	1.1414	20.10	28.65	25.25	52	1.5576	66.50		
19	1.1504	21.50	30.50	26.50	53	1.5742	67.75		
20	1.1596	22.50	32.15	28.25	54	1.5912	69.50		
21	1.1690	23.80	34.00	29.75	55	1.6086	71.00		
22	1.1785	24.80	35.00	31.10	56	1.6264	72.50		
23	1.1882	26.10	37.00	32.75	57	1.6446	74.25		
24	1.1981	27.50	39.50	34.50	58	1.6632	76.00		
25	1.2082	23.50	40.00	36.00	59	1.6823	77.50		
26	1.2184	30.00		37.75	60	1.7019	79.50		
27	1.2288	31.25		39.10	61	1.7220	80.75		
28	1.2394	32.75		40.75	62	1.7427	82.75		
29	1.2502	34.25		42.75	63	1.7640	84.75		
30	1.2612	35.75		44.75	64	1.7858	86.80		
31	1.2724	36.80		46.33	65	1.8082	89.25		
32	1.2838	38.25		48.20	66	1.8312	93.75		
33	1.2954	39.50		50.10	67	1.8548	100.00		
34	1.3072	41.00		52.25					

The other method — just alluded to — for determining the strength of these acids consists in finding out how much of the acid is required to neutralize a certain amount of an alkali. The alkali generally employed is a carbonate, such as pure carbonate or bicarbonate of soda, or bicarbonate of potassa. The latter substance is generally to be preferred, as it can more easily be procured in a state of perfect purity. It occurs in commerce in

crystals, and if well crystallized, colorless, and perfectly clear and transparent, its purity may be relied upon. It would be well, however, to select some of the best formed crystals from a lot, and to preserve them in bottles for use. It will seldom be necessary to reject more than a quarter or a third part of the whole.

When a test is to be made, reduce some of the crystals to a fine powder, and dry it between a few folds of bibulous paper, pressing it between the leaves of a book, or in some similar contrivance, until the paper ceases to absorb any moisture. Take 100.5 grains by weight of this powder, and transfer it into a small porcelain dish, add about one ounce of water, and heat to near the boiling point. Then take considerably more of the acid to be examined than is supposed to be necessary for saturating the above amount of alkali, pour it into a small and light flask, and weigh. Now add the acid gradually to the alkaline solution, stirring constantly with a glass rod, care being taken not to add too much acid at a time, lest such a violent effervescence should ensue as would cause the jerking away of some of the liquid. When the violence of the effervescence begins to abate, test the solution after each successive addition of acid with blue litmus-paper.

As soon as the paper is slightly reddened, stop adding the acid, and boil the liquor a few moments to expel all the carbonic acid gas absorbed by it. If the test-paper continues to be slightly reddened by the solution, it indicates that enough acid has been added; if it is not reddened, add a few more

drops of acid, until the desired reaction takes place. Then replace the flask upon the balance, and add weights enough to restore the equilibrium. This weight of course shows the amount of acid consumed in neutralizing 100.5 grains of bicarbonate of potassa, provided none of the acid has been spilled during the operation. The inexperienced manipulator generally finds it difficult to hit exactly the point when a sufficient amount of acid has been added to neutralize the alkali, and frequently adds too much, before he discovers the mistake. It is then necessary to repeat the experiment a second, and perhaps a third time, before that point is accurately determined.

100.5 grains of bicarbonate of potassa require for neutralization the following amount of acids:—

49	grs. of pure concentrated oil of vitriol.
40	" crystallized anhydrous sulphuric acid.
63	" hydrated nitric acid.
54	" anhydrous nitric acid.
36.42	" muriatic acid gas.
60	" hydrated acetic acid.
51	" hypothetical anhydrous acetic acid.

It is hardly necessary to mention, that the amount of the respective acids required in the above experiment corresponds to the quantity of pure acid indicated by these numbers. If, for example, 75 grains of sulphuric acid were required to neutralize the bicarbonate of potassa, then this acid would contain  $\frac{49 \times 100}{75} = 65\frac{1}{3}$  per cent. of pure oil of vitriol; or if 75 grains of acetic acid had been required for neutralization, then this acid would have contained  $\frac{51 \times 100}{75} = 68$  per cent. of anhydrous acetic acid.

If the acid under examination should happen to be a very dilute one, one half or quarter only of the above quantity of bicarbonate of potassa need be taken, so as to avoid the inconvenience of weighing a heavy quantity of the acid.\*

The strength of vinegar is, in commerce, often stated in degrees, which indicate the number of grains of bicarbonate of potassa required to neutralize one fluid ounce of vinegar, equal to about 500 grains. 1,000 grains, for instance, of vinegar of 50 degrees will be required for the neutralization of 100.5 grains of bicarbonate of potassa, and its strength will be  $\frac{51 \times 100}{1,000} = 5.1$  per cent. of anhydrous acetic acid.

The method pursued is, to heat the vinegar, and add to it enough bicarbonate of potassa from a weighed quantity to neutralize it. The residual weight of the bicarbonate, subtracted from the original weight, is the weight of the quantity consumed.

#### ACONITINE.

SYN. *Aconitia*; *Aconitina*.

ACONITINE is a very poisonous vegetable alkali; it is in the form of a semi-crystalline white powder, and is odorless, and has a bitter taste. It is very slightly soluble in water, but alcohol and ether dissolve it readily. Neligan states that, "as usually met with, it is of a grayish-yellow color, in which state it is very impure." When incinerated, it should leave behind no ashes. It is an exceedingly costly preparation.

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\* In this case the quantity of acid used must of course be multiplied by 2 or 4, to make the calculation according to the above data.

## ALCOHOL.

As alcohol unites in every proportion with water, it may be made of any strength; but it is generally referred to three standards, viz.:—

*Anhydrous or absolute alcohol*, having a specific gravity between 0.792 and 0.800.

*Rectified Spirit of Commerce*; *Spirit of Wine*; *Spiritus Rectificatus*, of the specific gravity of 0.835 to 0.840. And,

*Diluted Spirit*; *Standard or Proof Spirit*; *Spiritus Tenuior*, of the specific gravity of 0.912 to 0.920.

The strength of alcohol may be determined by weighing, either by means of a delicate balance, or by an hydrometer, distilled water being taken as 1. Baumé's *hydrometer for light liquids* is the one most generally used; and the following table gives the corresponding degrees, specific gravities, and alcoholic per centages, at 60° Fahrenheit.

Degree.	Sp. Gr. at 60°.	Alcohol per cent.	Degree.	Sp. Gr. at 60°.	Alcohol per cent.
47	0.796	100	28	0.889	63
46	0.800	98	27	0.895	60
45	0.805	97	26	0.900	58
44	0.810	95	25	0.906	55
43	0.814	93	24	0.911	52.5
42	0.819	91	23	0.917	50
41	0.823	90	22	0.923	47.5
40	0.828	88	21	0.929	44.5
39	0.832	86	20	0.935	42
38	0.837	84	19	0.941	39
37	0.842	82	18	0.948	35.5
36	0.847	80.5	17	0.954	32.5
35	0.852	78.5	16	0.961	28.5
34	0.858	76	15	0.967	25
33	0.863	74	14	0.974	20
32	0.868	72	13	0.980	15.5
31	0.873	69.5	12	0.987	11
30	0.878	68	11	0.993	5.5
29	0.884	65	10	1.000	0 at 68° F.

Alcohol has a burning taste, a penetrating, agreeable odor, and is a colorless, transparent, volatile fluid. It burns with a pale blue flame, emitting no smoke.

Pure alcohol should leave no residue on evaporation, should burn without smoke, ought not to emit any empyreumatic smell when rubbed between the hands, and should not redden blue litmus-paper.

The principal contamination of alcohol is *grain oil* or *fusel oil*. This may be detected by mixing the alcohol with hot water, when the odor of the *phlegm* will be revealed. If much fusel oil is present, the liquor will become milky. In the above experiment, rain or distilled water, or other pure water, must be used, as well-water, which almost always contains gypsum, would itself become milky with alcohol.

Alcohol which contains fusel oil should not be used in the preparation of medicinal tinctures, as such an alcohol might cause seriously bad effects, headache, nervous excitement, &c., the cause of which would be very likely to escape the observation of the physician.

#### ALCOHOLIC LIQUORS.

THESE are the products of the vinous fermentation of saccharine liquids. Some of them, the so-called *ardent spirits*, are obtained by the distillation of the fermented liquors, and contain alcohol in a concentrated form,—brandy, whiskey, rum, &c.; and others, like wine and beer, are not distilled, and alcohol is not their only important ingredient. In fact, alcohol

is not so much the active principle of ardent spirits as it is vulgarly supposed to be; and the very general erroneous opinions existing on this point have given rise to extensive adulterations of these articles, such adulterations being consequently considered unimportant and harmless. All the different alcoholic drinks contain peculiar flavoring principles, although in very small quantities. Their nature is as yet very little understood by chemists. Indeed, the flavor of not even one of these liquors has as yet been successfully imitated by art. It is known, for instance, that wine contains a compound ether, called œnanthic ether, to which, in some degree, its peculiar flavor is due; but nobody has yet succeeded in ameliorating poorly flavored wine, by adding œnanthic ether to it. Spirit made from potatoes and molasses contains potato fusel oil (hydrated oxide of anyle). Brandy made from rye contains rye fusel oil in small quantities; but it has yet been hardly studied by chemists. And probably every kind of spirits contains a peculiar fusel oil. But this fusel oil is not the only specific ingredient of such liquor, for on the addition of potato fusel oil to perfectly pure alcohol of the strength of potato brandy or New England rum, nothing very like these spirits is obtained. Pure diluted alcohol itself is unpalatable to the brandy-drinker.

It is a well-known fact, that the flavor of most liquors changes and improves by age. Ardent spirits, when recently prepared, are generally much more narcotic than when they are old, although they retain the same percentage of alcohol. Chemistry

throws very little light on this fact, there being no reagents by which to prove the genuineness and purity of these liquors, though they may readily be judged of by an exercised palate.

The adulterations which are practised on liquors are the mixing of cheaper with the more costly ones, and the addition of certain *spices* and *essences*. Such sophistications are very injurious in beverages, and more so than is generally supposed, especially in the case of wines. A mixture of two different wines, each of which by itself may be a wholesome beverage, will almost always sicken the drinker; and the same is the case with ardent spirits.

The flavor of ardent spirits is particularly developed when a small sample is mixed with from four to six times its bulk of boiling water. By comparing the flavor and odor thus produced by a suspicious article with that produced by a pure article, the purity of a liquor can generally be judged of.

Ardent spirits are often diluted with *water*, which is detected by the hydrometer, as shown under alcohol. The taste of the article is not always a sure guide in this respect, because the sophistication is often concealed by the addition of different kinds of *pepper*, *spirits of turpentine*, and *other substances* which increase the pungent taste of the liquor. A good judge of liquors will distinguish such an article from a pure one by the taste; but those who are not experienced in tasting liquors had better evaporate slowly a quantity of the liquor over a water-bath, to one half or one third its original bulk. The residue, containing less alcohol, will, upon cooling, show the

taste of the drug much more decidedly than the original liquor.

It is said that *prussic acid* is sometimes added to liquors to increase their intoxicating powers. To test for this, distil a quantity of the liquor cautiously, and add to the distillate a few drops of caustic potassa lye until a decided alkaline reaction is produced on test-paper. Subsequently acidulate slightly with acetic acid, and add a few drops of a mixed solution of a salt of protoxide with one of sesquioxide of iron. If prussic acid is present, a precipitate of prussian blue will be produced.

Liquors sometimes contain small quantities of *lead* or *copper*, which has been dissolved from the distilling apparatus. A stream of hydrosulphuric acid passed through such liquors will precipitate these metals as sulphurets, in which shape they may be collected and submitted to further tests if required.

Wine is that beverage which owes less to art for its composition and qualities. The nature of wine depends on that of the grape from which it is obtained. Manufacturers of wine generally find but little difficulty in conducting the fermentation and further treatment of that beverage. Consumers detect any fraud occurring in it with more facility than in any other liquor. More especially is this the case with the light and aromatic wines from the Rhine and from France. With the heavy, and especially the sweet, wines of Southern climates, there is more difficulty. Adulterations of wines are, however, seldom practised to any extent in countries where wine

is produced, or in communities accustomed to its use, where practised palates will be sure to detect them.

Mineral poisons seldom occur in them. Sometimes, however, small amounts of *sulphurous acid* and *arsenic* are met with, and also *oxide of lead*.

It is well known, that, in order to keep wine from acidification, especially in barrels which are not quite full, sulphur is burned over it. The sulphurous acid thus formed acts as an antiseptic. If sulphur is taken which contains arsenic, a circumstance which sometimes occurs through ignorance, the wine may be contaminated with arsenic. If wine is consumed soon after having been exposed to the action of sulphurous vapors, and before it has been oxidized by the oxygen of the atmosphere, it will give a bad headache to the drinker. A connoisseur of wine will detect this impurity by its taste and odor much better than it can be done by any chemical test, because it always occurs in very small quantities.

Lead is sometimes accidentally present, where wine-bottles are cleaned with shot, and some of the shot, or some of the dust produced during the rinsing, is left in the bottle through carelessness. It has also occurred that wine-dealers have added oxide of lead to wine to take away an excess of acid, most criminally careless of the consequences of their quackery. Even chemists have underrated the bad effect of this contamination, they having assumed that the lead would combine only with the tartaric acid, and form insoluble tartrate of lead. There are other acids in sour wine besides tartaric acid (malic, lactic,

and acetic acids), whose lead salts are more or less soluble. A stream of sulphurctted hydrogen will indicate the lead, if contained in wine.

To detect arsenic, the following process, given by Runge, is recommended by its simplicity. Mix the wine in question with its own bulk of pure concentrated muriatic acid, and immerse a bright piece of copper (a new copper coin for instance) in the liquid for about five or ten minutes, and heat gently at the same time. If arsenic is present, it will form a gray coating, or spots, upon the copper.

It is worthy of observation, that muriatic acid frequently contains traces of arsenic, and if diluted with an equal bulk of water, it will then give the above reaction with copper. The acid must therefore be thus tested for its purity before using it, by Marsh's test, which will also detect arsenic in an expeditious manner in wine.

The adulteration of superior with inferior wine has been spoken of above. The addition of *sugar* or *alcohol* to wine, before fermentation has stopped, can hardly be called an adulteration, if the substances thus added, by themselves, are pure. Pure grape or cane sugar, and pure alcohol (freed from all odoriferous principles by charcoal), or at least alcohol produced by distillation from wine itself, must be used.

That a certain proportion must not be exceeded is a matter of course, and if it has been exceeded the mere anomalous flavor of the article will show it. The skilful maker of wine learns from experience the right proportions. Wine thus prepared has

none of the bad qualities generally belonging to mixed wines, or to those to which sugar or alcohol has been added after fermentation.

In this country and in England very coarse and disingenuous adulterations are often practised, because there are so many who are not so good judges of wines as the people, for instance, on the continent of Europe.

Wine is often mixed with *cider*, *water*, and *alcohol*, or very *inferior wines*. Such fabrications are most frequently practised with red wines, and in this case some coloring matter is often added to impart to the liquid a strong red color. An infusion of logwood is most generally employed. Such adulterations can easily be recognized by tests.

Red wine, with no other than its native color, gives, with a solution of subacetate of lead, a bluish-gray precipitate, and with a little alum dissolved in it, and then some carbonate of ammonia, a gray precipitate. When wine is colored with false coloring substances, these will change the color of the above precipitates, causing them mostly to be reddish or bluish.

Sometimes chalk or alkalies are added to very acid wines to neutralize them. These substances might be discovered by the anomalous quantity of ashes which such wines would yield; unfortunately, however, too little is known at present as to the amount of ashes which the different wines contain in their normal state.

*Beer.*—This article is, of all the different alcoholic beverages, the most difficult and complicated one to

manufacture. Bad quality in beer is much more frequently the result of imperfect brewing or bad cellars for keeping, than of intentional sophistication.

It is generally known that the art of brewing beer has been brought to greater perfection in the kingdom of Bavaria than anywhere else. This fact is owing in a great measure to the attention which government has given to this matter, and the stringent police regulations which have been enforced there against the sale of all unwholesome beer.

The difficulty in producing a beer which is not liable to acidify by keeping is particularly great, unless it contain a large amount of alcohol, unless an excess of hops be used, or unless the malt be roasted to such a degree as to produce a large amount of empyreumatic matter. The Bavarian mode of brewing beer, and of keeping it in cold vaults, has obviated these difficulties better than any other method. Nowhere in the world is beer consumed in such prodigious quantities as in Bavaria, and some other places where Bavarian brewed beer has come into general use, without the slightest visible injury to the health of the consumers. It is probable that none of the different English brewed beers could be taken as freely as the Bavarian without detriment to the health, while a great deal of the beer sold in this country must be considered decidedly unwholesome. The great neglect shown here in not keeping beer in sufficiently cool places greatly augments its liability to turn sour. In fact, no beer which does not contain an undue amount of alcohol, hops, or empyreumatic matter could keep sweet

under such circumstances. An excess of alcohol in beer would not probably make it absolutely unwholesome, as long as consumers knew the fact, and did not partake of it too freely. It is generally desired and understood, however, that beer should be weak enough to allow of its being drank freely.

The following adulterations are often practised in the making of beer:—

*To save malt*, more or less molasses is often substituted for it. Such beer will, of course, contain all the impurities which were in the molasses,—all its salts and empyreumatic substances. Liquorice is also added to give a peculiar sweetness.

*To save hops*, various bitter herbs are substituted.

*To suit a depraved taste, or to make beer keep*, which would not keep without it, alcohol, in the shape of cheap ardent spirits, is added.

*To make beer very intoxicating*, narcotic drugs are added.

There are no expeditious and reliable tests to discover such frauds; these must be detected by the palate and the effects of the liquor.

Some of the signs of a good beer are,—1. Its perfect clearness and transparency. 2. Its coolness. 3. The cessation of fermentation in its rapid stage. 4. Its freedom from acidity.

Beer, after being boiled for a few minutes to drive out the carbonic acid gas which it contains, should give no acid reaction with blue litmus-paper, or but a very slight one.

## ALKALIMETRY.

THE quantitative determination of alkalies is an operation of frequent occurrence in the arts. The forms in which alkalies are to be tested are their carbonates ; as carbonate of potassa (potash, pearlash, saleratus ashes) ; carbonate of soda (soda ash, sal soda, barilla, and kelp) ; and sometimes water of ammonia.

The method which is generally pursued is to ascertain how much sulphuric acid is required to neutralize a certain amount of the alkali.

In order to simplify and expedite this operation as much as possible, the sulphuric acid is not weighed, but measured ; and to avoid the inaccuracies which would arise from the measuring of small quantities of the acid, the same is greatly diluted with water. Thus, any fault which occurs in measuring the test acid is diminished in proportion.

The instruments required for this operation are very simple. A balance with grain-weights, a well-graduated ounce measuring-glass, and a minim-glass. The measuring-glasses occurring in commerce are not always accurate ; the operator must, therefore, first test them. Let him measure in his minim-glass various quantities of water, or, what is better, quicksilver, if on hand in sufficient quantity, and transfer it to the ounce-glass, in which the liquid should stand at exactly the corresponding marks. 60 minims must show 1 drachm ; 120, 2 drachms ; 480, 8 drachms, &c. These marks must always agree, no matter in what way the measuring is made. Thus, by measuring

20 min. + 30 min. + 40 min. + 50 min. + 60 min. + 10 min. + 5 min. + 25 min., the sum-total is 240 minims, equal half a fluid ounce. If all these measurements, poured together into the ounce measure, should indicate in the same exactly one half-ounce, or very nearly so, the glasses may be taken as reliable; if not, they must be rejected.

The next step to be taken by the operator is the preparation of the test-acids for the different alkalies. As much sulphuric acid as will exactly neutralize 100 grains of pure potassa, soda, or ammonia gas in solution, is to be diluted with as much water as is required to make up the volume of 1,000 minims. The test-acid for potassa must contain 106 grains of strongest oil of vitriol in 1,000 minims; for soda, 160 grains; for ammonia, 294 grains.

To make half a gallon of either of these test-acids, take a bottle holding somewhat more than half a gallon, and make a mark in the glass by means of a diamond, file, or flint, at that point at which the bottle holds precisely that quantity of liquid.

Pour into the bottle a quart of pure water; then add 4 oz. 5 dr. 19 gr. of strongest oil of vitriol for potash test; 7 oz. 3 dr. for soda test; 12 oz. 7 dr. 31 gr. for ammonia (all by weight). This done, shake well, and add enough water to reach exactly the half-gallon mark, and shake again. If the oil of vitriol was of the right strength, and the manipulations were exactly executed, the test-acids will be so graduated that precisely 1,000 minims of them will neutralize exactly 100 grains of the respective alkalies. There will always be found smaller or larger

deviations from these points. If, on trial, the test-acid is found to be too weak, acid must be added; if too strong, water.

Since it is very difficult to procure in a state of purity, and to weigh accurately, 100 grains of these respective alkalies, their equivalent of pure bicarbonate of potassa is taken.  $212\frac{1}{4}$  grains of bicarbonate of potassa are equivalent to 100 of potassa; 320 grains of bicarbonate of potassa are equivalent to 100 of soda; 600 grains of bicarbonate of potassa are equivalent to 100 of ammonia.

The test-acid once prepared, the test itself is, of course, easily made. 100 grains of the alkali, or alkaline substance, are dissolved in a little pure warm water; if the solution be not clear, or, as in the case of ashes, earthy matter be present, it is filtered through a small filter into a small porcelain capsule, and the substance upon the filter is washed above the same, until every thing soluble is extracted. If the volume of solution thus obtained is more than about one fluid ounce, it is concentrated down to this quantity by evaporation.

The solution is then slightly heated, and the test-acid is added to it from the ounce measuring-glass, cautiously, and in small quantities at a time, until the solution reddens litmus-paper. If one ounce of the test-acid is consumed without producing neutralization, a second ounce is measured off, and as much added to the alkaline solution as may be necessary to neutralization. The test-acid which remains behind in the ounce-glass is measured off in the minim-glass, and thus the amount of acid used is found out.

Every minim of test-acid used indicates one tenth per cent. of alkali. Supposing 562 minims have been used, it indicates 56.2 per cent. of alkali.

Persons who have not frequently to determine all three alkalies may easily get along with one test-acid alone, by a little calculation.

As much test-acid as will neutralize one chemical equivalent of potassa, = 47.2, will neutralize one equivalent of soda, = 31.3, or one equivalent of ammonia, = 17. If, therefore, we were to test soda with a potassa test-acid, we should multiply the number of percentages found by 47.2 and divide by 31.3; or if ammonia, we multiply by 47.2, and divide by 17, &c.

#### ALKANET.

##### SYN. *Anchusa*.

THE root of a plant growing in the South of France, &c. When in perfection, the roots are about the thickness of the finger, having a thick bark of a deep purple-red color. It communicates its coloring principle to alcohol, ether, the oils, and fats. Cooley says, "In selecting this article, the smaller roots should be chosen, as they possess more bark than the larger ones in proportion to their weight."

#### ALOES.

THE principal varieties of aloes mentioned in the dispensatories are the *Socotrine*, the *Hepatic* or *East Indian*, the *Barbadoes*, and the *Cape*. Besides these, there is another variety of aloes held in high esteem in our market, and known as *Curaçoa aloes*. Indeed,

this and the Cape aloes are the only two varieties quoted in many of the Boston and New York newspaper prices-current, the Curaçoa aloes being quoted at about twenty cents per pound, while Cape aloes sells at not quite one half this price. The *less disagreeable* the odor of aloes the more highly it is prized, provided its physical aspect is good. The odor of *Socotrine aloes* is fragrant and aromatic, and the aloes yields a golden-yellow powder. *Hepatic aloes* has a weaker odor, and yields a duller-colored powder than the Socotrine. *Barbadoes aloes* has a strong, disagreeable odor, resembling that of the human axilla, and its powder is a dull olive-yellow. *Cape aloes* has a strong, disagreeable odor, and yields a greenish-olive powder. *Curaçoa aloes* has rather a fragrant, and not unpleasant odor, and yields a bright yellow powder. *Caballine* or *Horse aloes* is a coarse inferior sort of aloes, has a strong fetid odor, and is mixed with straw, sand, charcoal, &c.

Aloes has a very bitter, disagreeable taste, and a peculiar odor, increased by breathing on it. It softens by the heat of the hand. It is almost entirely soluble in cold water; it is insoluble in absolute alcohol, but is readily soluble in diluted spirit.

Aloes is not subject to adulteration, but the inferior may be substituted for the finer sorts, which fraud is readily detected by the experienced druggist.

#### ALUMINA AND POTASSA, SULPHATE OF.

SYN. *Alum*; *Alumen*.

ALUM is a double salt, composed of sulphate of alumina and sulphate of potassa. Sometimes alum

occurs in commerce (especially in France) which contains sulphate of ammonia, instead of sulphate of potash,—*ammonia alum*; but the *common alum* is the most important. As met with in the shops, alum is in transparent, colorless crystals, odorless, and having a sweetish styptic taste. When heated, it fuses in its water of crystallization; and when the water is entirely driven off, *burnt alum*, so called, remains behind. Alum dissolves in 18 parts of water at 60° F., and the solution exerts an acid reaction upon litmus-paper. Alum is very extensively employed in the arts, particularly in dyeing, lake-making, dressing sheep-skins, &c., &c. Several varieties of alum are known in commerce, as *Roche alum*, and *Roman alum*, having a rose color, owing to a slight covering of oxide of iron. These have the same composition as common alum; but Roman alum, unlike that, is generally free from sulphate of iron. It is probably never imported into this country.

Alum is not much subject to adulteration; but the accidental presence of even a small quantity of iron renders it very injurious to the dyer. A solution of alum should not be changed in color by prussiate of potash or tincture of galls, nor by sulphuretted hydrogen. Alum sometimes contains ammonia, the odor of which may be recognized by rubbing it with quicklime. “Powdered alum is commonly adulterated with large quantities of common salt” (Cooley); the solution of it then gives, with nitrate of silver, a precipitate soluble in ammonia.

## AMBER.

SYN. *Succinum.*

AMBER is a fossil substance of vegetable origin, greatly resembling copal. It occurs in irregular brittle masses, from "the size of coarse sand to that of a man's head." Its color is yellow, sometimes brownish or whitish, with a resinous lustre, and translucent. It is rendered electric by friction. Specific gravity 1.080 to 1.085. It melts at about 540°, and burns with a yellow flame and aromatic odor. It has no taste. It often contains insects, and "specimens of this kind are so highly prized as frequently to be imitated for the shops." It is found most abundantly on the Baltic coast, and it has been found at Martha's Vineyard, and other localities in the United States.

Amber is liable to adulteration with *resin*, *copal*, or *anime*. But these two latter substances have a different appearance and fracture; the resins, with the exception of amber, do not yield on fusion succinic acid.

"Amber may be known from copal by the following characteristics:—1. A bit of *copal*, heated on the point of a knife, catches fire, and runs into drops, which flatten as they fall. 2. *Amber* burns with spitting and frothing, and when its liquefied particles drop, they rebound from the plane on which they fall." Amber cannot be melted together with any resin without its appearance being changed.

## AMBERGRIS.

SYN. *Amber-grease; Gray Amber; Ambra Grisea.*

THIS substance is now supposed to be a morbid secretion formed in the liver or intestines of the spermaceti whale. It is found in irregular masses, floating on the sea, in tropical climates.

Ambergris is in solid, opaque, roundish, uneven, fatty, inflammable masses, of a light-gray color, darker externally than internally, variegated with brownish, yellow, and white streaks. These masses are lighter than water, and of a consistence like that of wax. Ambergris softens with the warmth of the hand, and when heated emits a peculiar, agreeable odor. It is readily soluble in hot alcohol and ether.

“From its high price (about 21s. per ounce retail) it is frequently adulterated” (Cooley’s Cyclop.), “and it is easily imitated by a mixture of several gums and other drugs” (Normandy). It is adulterated with wax, storax, benzoin, labdanum, starch, meal, and white sand, and scented with musk.

Ambergris should be chosen in large pieces, of a uniform gray color, internally lighter, with little black specks, and of an agreeable odor. Its specific gravity is from 0.908 to 0.92. It melts at 144° F. It should yield 85 per cent. of *ambrein*, which is obtained by treating ambergris with heated alcohol of sp. gr. 0.827, filtering the solution, and allowing it to stand, when crystals of ambrein will be deposited.

“The criterion of genuine ambergris is, that it may be easily perforated by a heated needle, and on with-

drawing it, not only should the odor of ambergris be immediately evolved, but the needle should come out clean, without any thing whatever adhering to it." (Normandy's Hand-Book.)

### AMMONIA.

SYN. 1. *Stronger Solution of Ammonia; Strong Ammonia; Ammoniæ Liquor Fortior; Ammoniæ Aqua Fortior.*

2. *Solution of Ammonia; Water of Ammonia; Ammonia; Spirits of Hartshorn; Volatile Alkali; Ammoniæ Liquor; Ammoniæ Aqua.*

AMMONIA is kept in the shops of two strengths, the stronger being directed to have the specific gravity of 0.882, and the weaker to have that of 0.96. Ammonia is also kept of five strengths, marked F, FF, FFF, FFFF, and concentrated or blistering ammonia.

Ammonia is a colorless, limpid fluid, with a pungent odor, and an acrid, alkaline taste. It changes the yellow color of turmeric to brown, and if a glass rod dipped in muriatic acid be held over it, dense white fumes will form.

*Tests.*— Pure ammonia must be colorless, and leave no residue upon evaporation on a watch-glass. It should not render lime-water turbid (*carbonic acid*), and after adding an excess of nitric acid, it should not be rendered turbid by a solution of chloride of barium or of lunar caustic, nor be colored by sulphuretted hydrogen.

*Impurities.*— The presence of *organic matter* may

be detected by the carbonaceous residue left on evaporation and ignition. *Resinous matter* may be detected by neutralizing a portion of the ammonia with muriatic acid, and evaporating over a water-bath, dust being very carefully excluded from the vessel; the resulting sal ammoniac will, if pure, be perfectly white, and entirely soluble in water.

Commercial *aqua ammonia*, as used for dyeing purposes, sometimes contains muriate, sulphate, and carbonate of ammonia, muriate of lime, and sometimes traces of protoxide of copper, or of peroxide of tin. For all of which impurities the tests have just been given.

The amount of real ammonia contained in the aqueous solution may be known either by the hydrometer, or by the specific-gravity bottle, or by the method given in the article on *Alkalimetry*.

*Davy's Table of Percentages of Ammonia, by Weight,  
at 59° Fahrenheit.*

100 parts of Sp. Gr.	contain	of Ammonia.	100 parts of Sp. Gr.	contain	of Ammonia.
0.8750		32.50	0.9435		14.53
0.8875	"	29.25	0.9476	"	13.46
0.9000	"	26.00	0.9513	"	12.40
0.9050	"	25.37	0.9545	"	11.56
0.9166	"	22.07	0.9573	"	10.82
0.9255	"	19.54	0.9597	"	10.17
0.9326	"	17.52	0.9619	"	9.60
0.9385	"	15.83	0.9692	"	9.50

The amount of ammonia may also be estimated by the amount of chloride of ammonium it will yield with muriatic acid. For this purpose, supersaturate a weighed quantity of ammonia with the

acid, evaporate over a water-bath, and dry at  $212^{\circ}$ . The amount of chloride of ammonium will indicate the amount of ammonia, 54 parts of the former being equivalent to 17 of the latter. When a test-acid is at hand, an alkalimetric test will answer the purpose more quickly and exactly.

Our usual hydrometers are not sufficiently exact to show small differences of specific gravity, and too unreliable in giving the true specific gravity. Very small differences in specific gravity correspond to large differences in the amount of ammonia; and therefore, if the determination of the specific gravity is not very accurate, it is worthless.

#### AMMONIA, CARBONATE OF.

SYN. *Subcarbonate or Sesquicarbonate of Ammonia; Volatile Salts; Smelling Salts; Baker's Salt; Ammoniæ Carbonas.*

It is a white salt, in semi-transparent, fibrous cakes or masses, of a pungent, ammoniacal odor, and a strong alkaline taste.

If not carefully protected from the air, it becomes opaque and friable, is converted into bicarbonate of ammonia, and loses much of its pungent odor. It is freely soluble in water, and in dilute alcohol, but very slightly in strong alcohol. Turmeric paper held over it is rendered brown.

The tests for carbonate of ammonia are its subliming entirely on the application of heat, its odor, and its effervescing with an acid.

It is seldom adulterated. But *fixed impurities* can

be detected by a residue being left after sublimation. *Organic matter*, such as empyreumatic oil, is indicated by impairing the whiteness or even the odor of it. When it is saturated by nitric acid, muriate of baryta or silver solutions should occasion scarcely any precipitate, thus showing the absence of *sal ammoniac*, or *sulphate of ammonia*.

#### AMMONIA, HYDROSULPHURET OF.

SYN. *Sulphide of Ammonium*; *Ammoniæ Hydro-sulphuretum*.

It is at first a colorless liquid, but after a while it assumes a yellow color. It has a very fetid odor. Sulphide of ammonium should be transparent, should leave no residue on evaporation, and should not give a precipitate with a solution of Epsom salts. It is extensively used as a chemical reagent. When recently prepared, it deposits no precipitate of sulphur upon decomposition by an acid. This will take place, however, after being exposed for some time to the air, higher sulphurets being formed by the influence of the oxygen of the air. For most applications this is of no consequence.

For method of preparing, see *Sulphuret of Iron*.

#### AMMONIA, SUCCINATE OF.

SYN. *Neutral Succinate of Ammonia*.

THE principal use of this salt is in chemistry to separate sesquioxide of iron from oxide of manganese and other oxides. It is also occasionally

used in medicine. It crystallizes in transparent anhydrous prisms, and gradually loses ammonia in the air. It has quite a pleasant taste. It should not give the slightest acid reaction with test-paper. It gives a reddish-brown precipitate with salts of sesquioxide of iron, soluble in acids.

Normandy states that "it is often adulterated with tartaric acid, or, according to Berzelius, it is sometimes altogether imitated by a mixture of tartaric acid and rectified oil of amber." The tartaric acid may be detected by ammonia giving no precipitate with salts of sesquioxide of iron in its presence. Also, on the application of heat, tartaric acid intumesces, gives off a characteristic odor of burning sugar or bread, and leaves a bulky carbonaceous mass, while succinate of ammonia is almost entirely volatile, leaving behind only a little charcoal.

#### AMMONIAC.

##### SYN. *Ammoniacum.*

AMMONIAC occurs in tears, and in masses made up of tears agglutinated together. The tears vary in size from that of a pea to that of an olive, and are yellowish externally, and white, like opal, internally. The masses are made up of tears and a brown connecting material. That is the best ammoniac in which the tears are the most predominant; the coarser sorts are composed of more agglutinating matter. Ammoniac has a powerful, peculiar color, and a bitter, nauseous, sweet taste. It is partly soluble in water, alcohol, and ether, and is composed

of about 70 per cent. of resin, 18 of gum, and a trace of volatile oil.

Ammoniac sometimes contains straws, seeds, sand, and other impurities, and when these are present in such quantities as to require purification — this process injuring the ammoniac — it should be rejected by the druggist.

#### AMMONIUM, CHLORIDE OF.

SYN. *Muriate or Hydrochlorate of Ammonia; Sal Ammoniac; Ammoniæ Murias.*

THIS salt occurs in commerce in large, flat cakes, somewhat convex on one side and concave on the other. It is somewhat translucent, and has a white or grayish color. It is difficultly pulverized, owing to its tenacity, but splits under the hammer into fibrous-shaped pieces. It is inodorous, and has a pungent, saline, bitterish taste. It is soluble in about three parts of water at 60°, and in its own weight of boiling water; it is also soluble in alcohol. It slightly reddens litmus (when pure it is perfectly neutral), and gives off ammonia when heated with lime. It sublimes entirely by heating, and this test will consequently detect any inorganic impurities. When resublimed it is known as *flowers of sal ammoniac*.

It is not liable to adulteration, but is almost always contaminated with *sesquioxide of iron* and *sulphates*. The latter are detected by the baryta test, and the iron by adding ammonia to a solution of it, and letting it remain for twenty-four hours for the precipitate to subside. Commercial sal ammoniac, when

white, is pure enough for medicinal purposes, but it must be purified for chemical purposes. The presence of empyreumatic oils will give a dirty color to the salt.

### ANGUSTURA BARK.

#### SYN. *Cusparia*.

"THE true medicinal angustura or cusparia bark is brought from the West Indies; but a spurious and poisonous species is imported from the East Indies, and is frequently sold for, or mixed with, the former. The following tabular view of the characteristics of each will afford a ready means of detecting this fraud."

*Tabular View of the Characteristics of the True and False Angustura Barks, drawn up by Dr. Pereira, from his own Researches, and those of Guibourt, Fee, and others.\**

	True Angustura Bark.	Nux Vomica, or False Angustura Bark.
Form.	Quills or flat pieces, straight or slightly bent.	Quills or flat pieces; short; often very much twisted like dried horn, arched backward.
Odor.	Disagreeable.	None or very slight
Taste.	Bitter, afterwards somewhat acrid; persistent.	Intensely bitter; very persistent.
Hardness and density.	Bark fragile when dry; easily cut, light; tissue not very dense.	Broken or cut with difficulty; heavy; tissue compact.
Fracture.	Dull and blackish.	Resinous.
Epidermoid crust.	Whitish or yellowish; insipid; unchanged or rendered slightly orange-red by nitric acid.	Variable; sometimes a spongy, rust colored layer; at other times whitish, prominent spots, more or less scattered or approximated. Nitric acid makes it intensely dark-green, or blackish.
Inner surface.	Separable into laminæ; deepened by nitric acid.	Not separable into laminæ; rendered blood-red by nitric acid.
Tinct. litmus.	Blue color destroyed.	Slightly reddened.
Sesquichloride of iron.	Flocculent dark grayish-brown precipitate.	Clear, yellowish-green liquor.
Prussiate of potash.	No change; hydrochloric acid causes a yellow precipitate.	Slight turbidness, not increased by hydrochloric acid.
Nitric acid.	A small quantity makes the liquor cloudy; a large quantity makes it a transparent deep red.	A small quantity makes the liquor clear and paler; a large quantity transparent red.

Infusion of the bark in  
24 parts of water, with

\* Taken from Cooley's Cyclopædia of Receipts.

## ANNOTTO.

SYN. *Annatto*; *Arnotto*; *Orleana*; *Rocou*.

ANNOTTO is a coloring matter of a pasty consistence. It is met with in commerce in *cakes* and *rolls*; the former, called *flag* or *cake* annotto, and which is by far the most important article, in a commercial point of view, is furnished almost wholly by Cayenne, and is imported in square cakes, weighing two or three pounds each, wrapped in banana leaves. It should be of a bright yellow color, soft to the touch, and of a firm consistence. *Roll* annotto comes from Brazil. The rolls are of two or three ounces' weight, hard and dry, brown outside, and red within. This latter species is used for coloring cheese and butter. When dry, annotto is hard and brittle, of a dull fracture, of a sweetish, peculiar odor, and a rough, saline, bitterish taste.

"Annotto contains two coloring principles;—a *yellow principle*, soluble in water and in alcohol, but little soluble in sulphuric ether; and a *red principle*, scarcely soluble in water, but very soluble in alcohol and ether. This substance is soluble in alkalies. A character which essentially distinguishes it from other yellow coloring matters is, that, treated by concentrated sulphuric acid, it passes to indigo-blue. Finally, little soluble in water, it is dissolved in alcohol and in the essential oils." (Persoz.)

"To estimate the quality of annotto, exhaust a given weight by a solution of caustic potassa; the alkaline liquor, saturated by an acid, abandons the

coloring matter, which may then be collected on a filter, washed, dried, and weighed. By incinerating annotto, there is left as a mean result eight to ten per cent. of ashes." (Persoz.)

Roll annotto is often adulterated with *red-lead* and *ochre*; the use of such annotto is injurious in admixture with cheese and butter. The lead is detected by placing a piece of the suspected article before the blowpipe, when a bead of metallic lead will be obtained; the ochre, by incinerating a given weight of the sample.

## ANTIMONY.

### SYN. *Stibium*.

ANTIMONY is a metal of silvery whiteness, having a slight blue tinge, and very brilliant. At a white heat, it gives off white vapors. It crystallizes from the state of fusion. It is very brittle, and easily reduced to powder in a mortar.

Antimony, when to be used for medicinal preparations, must be purer than it generally exists in commerce, and should be purified by Liebig's method. But for type-metal, small quantities of impurities are of no importance.

Antimony usually contains small quantities of *iron*, *lead*, *arsenic*, and *sulphur*.

If the antimony be deflagrated with *pure* nitre, and then treated with water, the filtered solution, acidulated with pure nitric acid, may be tested for sulphur and arsenic. If the former is present in it, a white precipitate will be given with chloride of ba-

rium (see *baryta test*) ; and if the latter is present, the solution will give a yellow precipitate with sulphuretted hydrogen, and a brownish-red precipitate with nitrate of silver (see *test for arsenic*, in the Appendix). Arsenic is also recognized by the *garlic odor* which is given off before the blowpipe. When powdered antimony is treated with *rather dilute* nitric acid, it is converted into a white powder, antimonic acid, which is insoluble. But the copper, lead, iron, and arsenic are dissolved. After driving off, by evaporation, the excess of acid, and then redissolving in water, these metals may be easily detected and separated from each other by chemical tests. The copper, lead, and arsenic are all precipitated by sulphuretted hydrogen, and the arsenic may be separated from the lead and copper, by washing well the precipitate with water, and then treating it with sulphide of ammonium, which will redissolve the arsenic, and this will be thrown down again of a yellow color by muriatic acid. The iron may be detected by sulphide of ammonium giving a black precipitate in the solution filtered off from the sulphuretted hydrogen precipitate.

#### ANTIMONY, OXIDE OF.

SYN. *Sesquioxide of Antimony*; *Nitro-muriatic Oxide of Antimony*; *Antimonii Oxidum*.

THIS is a heavy and inodorous powder. "When pure, it is entirely soluble in muriatic acid, and in a boiling mixture of bitartrate of potash and water;

fusible at a red heat; snow-white." It volatilizes in a small closed tube of Bohemian glass, before the blowpipe.

#### ANTIMONY AND POTASSA, TARTRATE OF.

SYN. *Tartar Emetic; Potassio-tartrate of Antimony; Tartarized Antimony; Antimonii et Potassæ Tartras.*

TARTAR EMETIC occurs either in the form of a white powder, or in colorless crystals, which on keeping become opaque; it is inodorous, but has a peculiar metallic, nauseous taste. The crystals effloresce in the air. Heat chars the salt, and sends off white fumes. It is soluble in 2 parts of boiling water, and in 15 parts of cold water. It is insoluble in alcohol, but is soluble in proof-spirit or wine.

Tartar emetic is subject to various adulterations, either from faulty preparation or from fraudulent additions. Among these may be mentioned *supertartrate of potassa, sulphate of potash, muriates, arsenic, lime, and silica.* The sulphate of potash is determined by the baryta test, the muriates by the silver test, the lime by the oxalic acid test, the silica by its insolubility in water, and iron by the solution giving a blue precipitate with prussiate of potassa, when previously acidulated with pure acetic acid.

There is more difficulty in determining the cream of tartar and the arsenic, owing to the former containing the same elements, and the latter giving very similar reactions with chemical tests to those given by tartar emetic.

The Edinburgh College gives M. Henry's test for detecting cream of tartar as follows: "A solution in 40 parts of water is not affected by its own volume of 8 parts of acetate of lead in 32 parts of water and 15 parts of acetic acid." Christison states that it is so delicate as to detect less than one per cent. of cream of tartar, but he adds that he has met with difficulties in using this test, which seem to render it too precarious for practice.

It seems to me that the best and easiest method would be to determine the amount of the antimony by throwing it down by sulphuretted hydrogen from a solution of the salt in water acidulated with a few drops of muriatic acid. The precipitate is golden-yellow tersulphuret of antimony, and, if the salt is pure, will amount to 49 per cent. It should be collected on a weighed filter, washed, dried at  $212^{\circ}$ , and weighed.

As arsenic would be likely to be present in small quantities only, and as that tartar emetic which contains any should be rejected, it is unnecessary to make any other than a qualitative search for it. See *arsenical tests* in the Appendix.

Tartar emetic should always be bought by the apothecary in good crystals, and not in powder. This would prevent the occurrence of gross frauds and adulterations. If there is any considerable amount of cream of tartar in it, it will remain undissolved in cold water, unless this is in excess. Good crystals of course do not contain cream of tartar, and this adulteration need not be looked for in them. Sulphide of ammonium ought to produce, in a solution

of tartar emetic, an orange precipitate, easily soluble in an excess of the precipitant, especially upon the application of a little heat. All other metals which may be likely to occur in it, except tin and arsenic, will remain undissolved.

#### ANTIMONY, SULPHURET OF.

SYN. *Crude Antimony; Antimony; Antimonii Sulphuretum.*

THIS is native tersulphuret of antimony purified by fusion. It occurs in rounded masses or loaves, of a steel-gray color, with a brilliant metallic, striated, crystalline fracture. It yields a black powder, is insoluble in water, but is completely soluble in strong muriatic acid with the aid of heat.

It is liable to contain several impurities, such as *iron, lead, copper, arsenic, &c.* The arsenic must be tested for by fusing it with nitre and carbonate of soda, or of potassa, as directed under *arsenical tests.* The lead and copper are tested for in the muriatic solution by sulphuretted hydrogen, which forms with them black precipitates, insoluble in sulphide of ammonium, and iron gives a blue precipitate with prussiate of potassa.

#### ANTIMONY, GOLDEN SULPHURET OF.

SYN. *Oxysulphuret of Antimony; Precipitated Sulphuret of Antimony; Antimonii Sulphuretum Præcipitatum.*

THIS is a light powder of an orange color, odorless and tasteless when pure. It is liable to the same

contaminations as the sulphuret of antimony, and these may be tested for in the same way. It is also sometimes adulterated with *sulphur*, *Venetian red*, and some *red coloring woods*. These are all left in an insoluble state when a portion of the substance is heated with muriatic acid. It is also reported that it is sometimes largely adulterated with gypsum; this is easily detected by boiling a portion with water, and testing the filtrate for sulphuric acid by the baryta test, and for lime by the oxalic acid test. Gypsum is also insoluble in potassa lye or concentrated muriatic acid, in both of which sulphuret of antimony is soluble.

It should be remembered that the terms Golden Sulphur (Penta-sulphuret of Antimony), and Oxy-sulphuret of Antimony (Kermes Mineral of the German and French), are improperly applied to the preparations of the United States and the English pharmacopœias. These terms, as used by the ancient pharmaceutists generally, and by the German and French to this day, are very different articles from the above, and can by no means be confounded with each other.

## ARCHIL.

SYN. *Orchil.*

ARCHIL is prepared from several species of lichens, and is imported from Great Britain as a pasty liquid. It is of a violet-blue color, and differs very much in quality. To test this, a piece of cloth must be dyed with it, and then compared with cloth dyed with a standard article. To dye with archil, diffuse a

known quantity of it in a known quantity of warm water; when this is ready to boil, a certain weight of cloth is steeped in it a certain length of time.

### ARROW-ROOT.

SYN. *Maranta*.

GENUINE arrow-root is always described as *Bermuda, St. Vincent, St. Kitts, or West Indian Arrow-root*. It is odorless and tasteless, is in the form of a very white powder, often aggregated into smaller masses, crackling between the fingers. Examined by the microscope, it is seen, like other varieties of fecula, to consist of small elliptical grains, varying in size from a 2000th to a 750th of an inch in their longest diameter. Three qualities are met with, called first, second, and third, which differ in their whiteness, and slightly also in their odor and taste. The first is imported in tin canisters or cases, the other two in boxes and cases.

Arrow-root is very apt to be *musty*, and should then be rejected. It is often adulterated with *common starch* or *potato-starch*. This admixture, if at all large, can easily be detected by an attentive examination with the naked eye, or, if in less quantities, by means of the microscope, the grains of the genuine article being much smaller. The admixture of potato-starch imparts to it an acrid, earthy, unpleasant flavor.

Stirred up in a mortar with double its weight of a mixture of equal parts of aquafortis and water, it does not become gelatinous and adhesive in less than fifteen minutes. (Dr. Scharling.)

One dram of potato-starch mixed in the same way forms rapidly a very stiff and tenacious jelly. Five per cent. of potato-starch, mixed with West Indian Arrow-root, may be detected in this way. (Scharling.)

On mixing potato-starch with muriatic acid, a smell resembling fresh beans or rushes may be perceived.

*East Indian Arrow-root* does not crepitate between the fingers like West Indian Arrow-root, nor make so firm a jelly.

#### ARSENIOUS ACID.

SYN. *White Arsenic; Arsenic; Ratsbane; Acidum Arseniosum.*

ARSENIOUS ACID, when recently prepared, is in colorless, vitreous cakes or masses. But the fragments, after some time, become opaque, and assume the appearance of porcelain. This change proceeds gradually from the surface inwards, and when one of these pieces is broken which has externally the appearance of porcelain, the centre will often be found still vitreous. Arsenic has sometimes a yellowish tinge. The cakes are moderately hard or brittle. It is inodorous, and has a faintly sweetish taste. Exposed to a heat of  $380^{\circ}$  F. it sublimes, and as it cools condenses into small transparent crystals of adamantine lustre, which are regular octahedrons. Thrown on to a heated brick, it volatilizes in white fumes, emitting a very indistinct odor; but if a fragment is placed upon a piece of burning charcoal, a very

strong odor of garlic is at once given off. White arsenic is sparingly soluble in water. Its best solvent is muriatic acid. It is dissolved also by solutions of the alkalies and alkaline carbonates.

The pulverized white arsenic of commerce is adulterated with *white sand, chalk, gypsum, ground bone-ashes, or sulphate of baryta*; but these may all be detected and their amount estimated, for arsenic is entirely volatilized at a heat of 380° or 400°. For this purpose heat a given weight of it in a small porcelain crucible, *under the hood of a chimney*, or in the open air, to prevent the inhalation of the noxious gases.

#### ARSENIC, TERSULPHURET OF.

SYN. *Yellow Sulphuret of Arsenic; Sesquisulphuret of Arsenic; Sulpharsenious Acid; Orpiment; Hartal; King's Yellow.*

ORPIMENT is of a pure yellow color; it is fusible and volatile. Two varieties occur in commerce; one is in beautiful foliated crystals of a golden-yellow color, and is the pure sulphuret; the other is in opaque, dull-yellow masses, and contains a very large proportion of arsenious acid. When orpiment contains an excess of *white arsenic*, this may be determined by extracting it with boiling water, in which pure orpiment is nearly insoluble. Orpiment in powder is often adulterated with *yellow ochre* or *brick-dust*, which may be easily determined, as orpiment entirely sublimes on the application of heat, and is soluble in hot caustic potassa.

## ASHES.

THE amount of alkaline salt which ashes contains may be ascertained by the method described under Alkalimetry. Ashes contains a large amount of earthy matter, &c., with a very small proportion of alkali.

The operator should therefore take 1,000 grains of the ashes, and boil them for ten minutes with seven or eight times their weight of water, then throw the whole upon a filter, and wash until the filtrate ceases to color turmeric paper brown. The filtered liquor is then examined with test sulphuric acid, as described in the article on Alkalimetry.

## ASSAFŒTIDA.

ASSAFŒTIDA occurs both in tears and lumps; the tears, not often met with in commerce, vary in size from a pea to an almond, yellowish-white externally, but milk-white within, passing gradually to a fine rose tint on exposure to the air.

Most of the assafœtida of commerce occurs in amygdaloid lumps, of from half a pound to three pounds in weight. They consist of whitish tears agglutinated together with a deeper-colored connecting matter. The assafœtida is better according to the larger proportion of the tears over the connecting matter. In the best sorts the lumps are of a mottled, yellowish, brownish-yellow, and rose-red color externally; milk-white internally, passing gradually to rose-red on exposure to the air; they are brittle at ordinary

temperatures, but are easily softened by the heat of the hand. In the inferior sorts the outer surface presents rather a brownish-red hue, and the surface of a fresh fracture shows a greater extent of brownish matter, and the whole consistence of the lumps is softer, so as at common temperatures even to receive the impression of the finger. Its principal constituents are resin, gum, and volatile oil. Water forms an emulsion with it, and spirit dissolves chiefly the resin and oil, and also some of the gum. Assafœtida has a powerful odor, resembling that of garlic, and a strong, peculiar, bitterish, somewhat acrid taste. It is imported in mats, cases, or casks.

“ This gum resin is frequently adulterated with gums of an inferior price, with chalk, clay, sand, &c. All these impurities may be detected by dissolving a given weight in a mixture of alcohol and an acid or an alkali; the impurities are then left in an insoluble state, and their amount may be determined by weighing. The insoluble portion in the genuine gum should not exceed 15 or 16 per cent.” “ It is also mixed at times with common resin, or turpentine, or other resinous substances. Those sorts ought to be rejected which are very soft, which contain few tears, which present a brown agglutinating medium, abundant, soft, and not rendered rose-colored by exposure, which exhale a pitchy odor in burning, or in which sand, stones, and other mechanical admixtures abound.”

## BALSAM OF PERU.

SYN. *Balsamum Peruvianum.*

BALSAM OF PERU is a thick, semi-transparent liquid, of a dark reddish-brown color. It has an agreeable, balsamic odor, and a warm, bitterish taste. The specific gravity should not exceed 1.160, nor be less than 1.150. It is insoluble in water, partially soluble in ether, but soluble in alcohol. It is said to be sometimes adulterated with *alcohol* or *fixed oils*. The first fraud is known by its low density, and by its undergoing diminution in volume when mixed with water. When agitated with water, the oil may be detected by its separating from the balsam and floating on the surface.

## BALSAM OF TOLU.

SYN. *Balsamum Tolutanum.*

TOLU comes in solid resinous-like masses, and of a reddish-yellow color. It has a fragrant balsamic odor, and an aromatic, warm, sweet taste. It is soluble in alcohol and ether, and imparts its fragrance to water.

"It is frequently adulterated, in which case it has a weaker smell, is less soluble in alcohol, and the tincture formed with that fluid is opaque." (Cooley.)

Balsam of Tolu should also yield benzoic acid by distillation.

## BARIUM, CHLORIDE OF.

SYN. *Muriate of Baryta; Hydrochlorate of Baryta; Barii Chloridum.*

THIS salt crystallizes in flat, four-sided tables, bevelled at the edges, is colorless, transparent, and odorless, and has a bitter, nauseous taste. It effloresces in very dry air. It is very soluble in water, insoluble in absolute alcohol. A saturated solution boils at  $222^{\circ}$  F. It is chiefly employed as a chemical reagent to detect and estimate sulphuric acid.

It should not affect vegetable colors, nor should a solution of it in water be troubled by hydrosulphuric acid, or sulphide of ammonium; precipitated by pure sulphuric acid, the filtered liquid should not yield any residue when evaporated upon platinum-foil.

Lead is a contamination which frequently occurs in it. It is frequently prepared on the large scale in leaden vessels, and it then always takes up some lead, its solution reacting strongly upon that metal.

## BARYTA, CARBONATE OF.

THE prepared carbonate of baryta should be a perfectly white powder, and is insoluble in water. It should dissolve entirely in pure hydrochloric or nitric acid, which would not be the case were it adulterated with *sulphate of baryta*. If sulphuric acid is added to the above solution, all the baryta will be thrown down as a sulphate, and this precipitate, if washed, dried, ignited, and weighed, should be in the proportion of 117 grains for every 99 grains of the

carbonate employed. The filtered liquor should, after evaporation and slight ignition, leave no residue whatever.

#### BARYTA, NITRATE OF.

THIS salt, which is extensively used in chemical analyses, crystallizes in regular octahedrons. It is soluble in eight parts of cold water, and in three parts of boiling water. It is much less soluble in an acid liquor. Nitrate of baryta should not affect vegetable colors, nor should it give a precipitate with sulphuretted hydrogen, sulphide of ammonium, or nitrate of silver. When precipitated by pure sulphuric acid, the filtered liquor should not leave the slightest residue when evaporated to dryness. It should not communicate to the alcohol-flame the red color that the strontia salts do.

#### BARYTA, SULPHATE OF.

SYN. *Barytes.*

THE specific gravity of sulphate of baryta is very great,—being 4.4. This salt is insoluble in water and in dilute acids. It occurs in commerce as a white powder, and the finer the powder, the more esteemed is the article. It is very extensively used to adulterate white-lead (which see), and also many other paints and chemicals. It is also used to increase the weight of paper, and for other fraudulent purposes.

It is peculiarly adapted for adulterating purposes, on account of its great specific gravity, its cheapness,

and its great power of resisting chemical reagents. The best method of detecting it in particular cases will be found detailed in different sections of this work. Ignition with charcoal reduces the salt, and a sulphuret of barium, soluble in water, is formed, which solution will blacken a silver coin.

#### BENZOIC ACID.

SYN. *Flowers of Benzoin.*

It usually occurs in white, pearly scales, which are flexible, of a peculiar balsamic, somewhat empyreumatic odor (pure benzoic acid is odorless), and of an acrid, feebly acid taste. It is sublimed entirely by heat, and may be detected by its irritating and cough-provoking vapors. Water dissolves it sparingly; rectified spirit more freely; solution of potassa or lime dissolves it entirely; and muriatic acid reprecipitates it.

“It is not liable to adulteration, but is often badly prepared, being contaminated with an excess of empyreumatic substances and coloring matter, and with inorganic matter. The latter remains, on subjecting the acid to sublimation;—the former may be detected by the sight and odor. The common officinal benzoic acid, on being heated, leaves a small carbonaceous residue.” (Fresenius.)

#### BENZOIN.

SYN. *Gum Benjamin; Styrax Benzoin.*

BENZOIN occurs in the market in two forms;

one, called *amygdaloid benzoin*, consisting of whitish tears united by a reddish-brown connecting medium, and the other, *sorted benzoin*, of brown or blackish masses, without tears. "The French pharmaceutists describe another variety in tears of a pale-yellow color; but it is not met with in the English market." (Neligan.) That benzoin is the most esteemed in which the white tears most prevail over the reddish-brown mass.

Benzoin is firm, brittle, and pulverizable. It has an agreeable, balsamic odor, which is especially evolved by heating it on hot sand or a stone, and a sweetish, balsamic, resinous taste. The odor and taste of the inferior kinds are much less agreeable. It is inflammable, burning with a fuliginous flame, and emitting irritating fumes. It is soluble in alcohol, rectified spirits, and ether.

"The amygdaloid benzoin contains 12 to 15 per cent. of benzoic acid; the sorted, 9 to 10 per cent.; and the benzoin of Siam, 8 to  $8\frac{1}{2}$  per cent." (Berzelius.)

The amount of benzoic acid contained in benzoin may be very accurately estimated as follows: "Add to the benzoin three times its weight of alcohol at 0.75, and saturate the benzoic acid with carbonate of soda dissolved in eight parts of water. Finally, add two parts of alcohol, and distil the decanted liquid to separate the greatest part of the alcohol. The resin which was dissolved in the liquor is separated, and only benzoate of soda remains in solution; this salt is decomposed by sulphuric acid, and the benzoic acid is almost completely separated from the cold liquor." (Regnault.)

## BISMUTH.

SYN. *Tin Glass; Marcasite; Bismuthum.*

BISMUTH is a grayish-white metal, with a reddish tint; this tint may be readily recognized by placing a piece of bismuth by the side of a grayish-white metal, such as zinc, antimony, &c. Its density is 9.8. It presents a crystalline fracture. It is brittle when cold, but somewhat malleable when heated. It fuses at 476° F.

The bismuth of commerce is never pure, but is contaminated with *arsenic, sulphur, lead, silver, iron, copper, tin, &c.* The arsenic and sulphur may be detected by fusing a portion of it with nitre, when a sulphate and arseniate of potassa will be formed, which may be extracted with water. The solution is to be neutralized with pure nitric acid, and tested with chloride of barium for sulphuric acid, when a white precipitate will form, insoluble in muriatic acid; if any arsenic is present in the solution, nitrate of silver will cause a reddish-brown precipitate, and sulphate of copper a greenish-blue one. To detect the other impurities, treat a portion with nitric acid; should any tin be present, it will remain undissolved as a white powder, hydrate of binioxide of tin. A portion of this solution will, on the addition of ammonia in excess, assume a fine blue color, if any copper is present; and will yield a precipitate of Prussian blue with prussiate of potassa, if iron is present. If chloride of sodium gives a white precipitate, soluble in ammonia, then silver is present; but if the

precipitate is not soluble in ammonia, then lead is probably present; and this is actually found to be the case, if a white precipitate takes place on the addition of diluted sulphuric acid.

*The Tests for Bismuth.*—It is entirely soluble in nitric acid with the aid of heat; and the solution is colorless, or nearly so, and deposits a white powder when poured into a large quantity of water.

#### BISMUTH, SUBNITRATE OF.

SYN. *Nitrate of Bismuth*; *Trisnitrate of Bismuth*; *White Bismuth*; *Magistery of Bismuth*; *Pearl-White*; *Fard's Spanish-White*; *Bismuthi Subnitratas*.

SUBNITRATE OF BISMUTH is a white, heavy, tasteless, and inodorous powder. It is slightly soluble in water, from which it is precipitated in small brilliant crystals by heating. It is readily soluble in dilute nitric acid. It is sometimes adulterated with *chalk* and *white-lead*, both of which are easily recognized by their effervescing on the addition of an acid; the lead is also precipitated from the nitric acid solution by sulphuric acid.

I have bought an article for subnitrate of bismuth, which proved to be *chloride of bismuth*; the chloride is distinguished by giving off, when drenched with sulphuric acid, fumes having the peculiar odor of muriatic, and not of nitric acid. Nitrate of bismuth, like all other nitrates, when heated with copper turnings and sulphuric acid, gives off brownish

fumes, by which it is easily recognized and distinguished from the chloride. Sometimes it contains a little silver, which injures it as a cosmetic; this may be detected by muriatic acid giving a white precipitate in the nitric acid solution.

#### BLACK LEAD.

SYN. *Plumbago*; *Graphite*.

BLACK LEAD is a species of mineral carbon, of a dark steel-gray color, and a metallic lustre; it is soft, has an unctuous feel, and leaves a dark-colored line, when drawn along paper. It is used for making lead-pencils and crucibles, for polishing stoves, &c., and for the electrolyte.

It is stated to be sometimes adulterated with *sulphuret of antimony*, *micaceous iron ore*, and *lamp-black*.

It is difficult to conceive why plumbago should be adulterated with lamp-black, or sulphuret of antimony, as these articles are of higher price than the article itself.

It is also said to be sometimes contaminated with *sea-salt*, which renders it unfit for making crucibles. By boiling a portion with distilled water, filtering, and evaporating the clear liquid, the salt will be left as a crystalline residue.

It will hardly ever be required to make a regular chemical examination of plumbago, since it is as easy to ascertain by direct trial, on the small scale, whether it is fit for the purposes for which it is intended.

## BONE-BLACK.

THE quality of bone-black depends upon the amount and nature of the carbon contained in it: The darker-colored it is, and the less brilliant and shining its particles are, the better it is. In order to compare different samples of bone-black, they should be ground in a mortar to an equal degree of fineness. The microscope might be of advantage, in helping to judge of the quality of bone-black. Another method of comparing the value of different samples is, to ascertain how much of each is required to decolorize an equal amount of some colored liquor, as tincture of litmus. The samples must be ground equally fine before making this experiment.

Bone-black is ground to different degrees of fineness for different applications.

## BORACIC ACID.

SYN. *Sedative Salt*; *Sedative Salt of Vitriol*; *Salt of Homberg*.

THE artificial boracic acid is apt to contain a little *sulphuric acid*, which may be detected by chloride of barium giving a white precipitate insoluble in muriatic acid.

The boracic acid of commerce is extracted from the acid lagoons of Tuscany. It contains from 18 to 25 per cent. of foreign matters. Crystallized boracic acid occurs in thin, shining plates, and contains 43.6 parts of water of crystallization. The solution

of boracic acid has hardly any acid taste ; it imparts to litmus a wine-red tint, and renders yellow turmeric paper-brown. It is soluble in twenty-five times its weight of cold, and three times its weight of boiling water; it is also very soluble in alcohol, which, when kindled, burns with a bright-green flame, if this acid is present.

#### BRAZIL-WOOD.

THIS term embraces several dye-woods from different species of the *Cæsalpina*, such as,— 1. *Fernambuco Wood*; 2. *Sapan Wood*; 3. *Nicaragua, or Peach Wood, St. Martha and Lima Wood*; and 4. *Brazileto Wood*.

Brazil-wood is pale when fresh, but becomes red on exposure to the air; it has different shades of red and orange. Its goodness is particularly determined by its density. It has a saccharine taste on being chewed. It yields its coloring matter to water, which serves to distinguish it from red sanders wood, and also to alcohol and ether. The color of Brazil-wood is less deep than that of logwood; but, according to Persoz, Brazil-wood is more particularly distinguished from logwood by its infusion not being precipitated blue, like an infusion of logwood, by lime, baryta, protochloride of tin, and acetate of lead, but by being precipitated of a crimson-red color by them.

#### BREAD.

THE adulterations to which bread is liable are *damaged flour, bean flour, &c., boiled potatoes, alum,*

*carbonate of magnesia, carbonates of potash and soda, carbonate of ammonia, chalk, plaster of Paris, clay, sulphate of copper, and sulphate of zinc.*

Alum may be detected in bread by treating it with distilled water, boiling, filtering, and then dividing the clear liquor into two portions, to one of which add a few drops of chloride of barium, and to the other a few drops of ammonia. If, in the first case, a white precipitate, insoluble in muriatic acid, and in the latter, a light gelatinous precipitate, redissoluble by a few drops of solution of potassa, takes place, alum is present.

“To detect carbonate of magnesia, ignite in a crucible half a pound of the suspected bread, pulverize the remaining ash, add acetic acid, and evaporate nearly to dryness to expel excess of acid; act on the residue with alcohol and filter. Evaporate the filtered liquor nearly to dryness, and dissolve in water; add an excess of ammonia and phosphate of soda, collect the precipitate on a filter, wash, dry, ignite, and weigh; every 100 parts of the résidue indicate 76 parts of carbonate of magnesia.” (Mitchell on Food.)

The most delicate test for sulphate of copper is ferrocyanide of potassium; bread containing only  $\frac{1}{500}$ th of sulphate of copper immediately takes a red tinge when moistened with a solution of the ferrocyanide.

To detect sulphate of zinc, take about one fourth of an ounce of the suspected bread, digest in distilled water, strain and filter. Evaporate the filtrate to dryness, and redissolve the residuum in water.

Add ammonia in excess, and if this causes a turbidness, again filter; should sulphuret of ammonium now cause a white precipitate in the filtered liquor, it is owing to the presence of zinc.

“Chalk, whiting, burnt bones, plaster of Paris, &c., are easily detected by burning a little of the bread in a clean, open vessel, when the amount of ashes left will indicate the quantity of adulteration. The quantity of ashes left by genuine flour is about one and a half per cent.” See *Flour*.

### BROMINE.

SYN. *Brominium*.

BROMINE is a deep-red liquid, of a strong, disagreeable, suffocating odor, and stains the skin yellow. It is slightly soluble in water, more so in alcohol, and very soluble in ether. It destroys the color of sulphuric acid, and imparts an orange-yellow color to starch paste. It evaporates at ordinary temperatures, exhaling acrid fumes.

### BURGUNDY PITCH.

SYN. *Pix Burgundica*.

GENUINE Burgundy pitch is reddish-brown, with a fragrant terebinthinate odor, friable in cold weather, but easily rendered softish and tenacious by heat. Several factitious substances are made and sold for Burgundy pitch, such as resin made opaque by incorporation with water, and yellow with palm-oil, &c.; but these inferior articles, when heated, want the peculiar odor and viscid adhesive property of the genuine sort.

## CAJEPUT OIL.

SYN. *Kyapoótie Oil; Oleum Cajuputi.*

CAJEPUT OIL is an essential oil distilled from the leaves of a tree growing in the Moluccas ; the crude oil of commerce is of a fine green color, but when redistilled it is colorless. It is a very liquid oil, and possesses a strong odor, partaking both of camphor and of cardamoms, and a corresponding taste succeeded by an impression of coolness. Its specific gravity is about 0.925 and it boils at 343°. Sulphuric and nitric acids have but little action upon it.

Cajeput oil sometimes contains copper, and is often adulterated and imitated with oil of rosemary, savin, or turpentine, impregnated with camphor and cardamom seeds, and colored with the resin of milfoil. Copper may be detected by a residue being left after ignition, which when dissolved in an acid gives the characteristic blue coloration with ammonia, and the copper spot on a piece of bright iron.

If a drop of this oil is let fall on water, it diffuses itself on the surface and afterwards evaporates, which is regarded as a test of its purity, though perhaps a very slender one ; it burns rapidly without leaving any residue.

## CALCIUM, CHLORIDE OF.

SYN. *Muriate of Lime; Hydrochlorate of Lime; Calcii Chloridum.*

THIS salt usually occurs in broken white lumps, but sometimes in crystals. The lumps or masses,

when pure, are anhydrous, but the crystals contain 49.13 per cent. of water.

Chloride of calcium is inodorous, has an acrid taste, and attracts moisture powerfully from the air. It is very soluble both in water and in alcohol.

A solution of chloride of calcium must be neutral to test-paper, must neither be tinged brown, nor give a precipitate with sulphide of ammonium (a sign of the presence of *iron* or *alum*), and should not evolve the odor of ammonia when boiled with lime.

#### CAMPHOR.

##### SYN. *Camphora.*

THERE are two varieties of camphor, the *common* and the *Borneo* camphor. The latter seldom occurs in commerce, and is distinguished from the former by its alliaceous odor, and by sinking in water. *Common* camphor comes in cakes, and is refined from the *crude* camphor. It should entirely sublime when gently heated, and should float on water, and ordinary alcohol should dissolve about 75 per cent. of its weight. It is stated to be at times adulterated with *spermaceti* and *white wax*, but these can be detected by their insolubility in cold alcohol.

#### CANELLA-BARK.

##### SYN. *Canella Alba.*

THIS bark occurs both in quills and in flat pieces. "It is easily known from all other barks by its very pale yellowish-white color, and its bitterish, acrid,

aromatic taste, intermediate between that of pepper and cloves. Its odor is feeble, and intermediate between that of cloves and cinnamon." It is often confounded with *winter's bark*, to which it has very little resemblance in appearance, winter's bark being of a reddish-yellow color, with red oval spots.

#### CANTHARIDES.

SYN. *Spanish Flies*; *Blistering Flies*; *Cantharis*; *Lytta*.

CANTHARIDES have a faint, disagreeable odor, and an acrid taste. The powder is of a grayish-brown color, with shining green spangles intermixed. The best Spanish flies are imported from St. Petersburg, and have more of a coppery cast than those of Southern Europe, the latter having rather a brassy tint.

In the whole flies any adulteration with other insects is detected by close inspection. The powdered flies, and consequently preparations made with them, such as blistering-plaster, are liable to adulteration with *euphorbium*. This adulteration can probably be best detected by the microscope, as nothing but insect texture should be visible in the powdered flies.

Spanish flies are very apt to be infested with *mites*, which are visible under the microscope.

#### CARMINE.

CARMINE is of a beautiful purple-red color, fusible at 122° F., and is prepared from cochineal. "There are sold at the shops different kinds of carmine,

depending upon two causes; either upon the mode of its preparation, or upon a certain quantity of adulterations put in to dilute the color." Carmine is liable to adulteration with *vermilion* and *red-lead*, but its purity may be known by its dissolving wholly in ammonia and forming a deep pink color. The finest is the lightest, and a good test is the filling a very small capsule or glass tube with the specimens and weighing them.

## CASTOR.

SYN. *Castoreum*.

CASTOR is a peculiar secretion from certain follicles of the castor or beaver. Two sorts occur in commerce, the *Russian* or *Siberian* (which is very rare and costly), and the *American* or *Canadian*, which is the usual article of commerce. Wood and Bache state, that "that which is brought to Philadelphia is derived chiefly from Missouri."

Neligan says: "As met with in commerce, North American castor consists of the two sacs united together by a kind of natural ligament; they are wrinkled, of a reddish-brown color externally, paler internally, breaking with a somewhat resinous fracture, sometimes quite hollow in the centre. They have a strong, peculiar, disagreeable odor, and a somewhat aromatic, bitter taste."

Castor is adulterated with *dried blood*, *galbanum*, *gum ammoniac*, or *wax*; sometimes metallic substances are introduced into the sacs to increase the weight. But good castor should be dry, very odor-

ous, and should be inclosed in perfect sacs, and these should be intersected with membranaceous partitions.

## CASTOR OIL.

SYN. *Oleum Ricini.*

THERE are two sorts of castor oil in the market, the East Indian and the American; *approved brands* of the latter are the most esteemed in our markets, as being less nauseous; but excepting these, the former is most esteemed.

Good castor oil has a very pale yellowish tinge, considerable unctuous viscosity, a faint, sweetish taste, and scarcely any odor. It has a density of .964 at 60°. It is soluble in alcohol, and rectified spirit takes up about a third of its volume; a property not possessed by any other fixed oil, except the concrete palm oil, and by which means, consequently, its adulteration with them may be detected.

The poorer American oil is said to be adulterated with *lard oil*; but this impurity can be easily recognized by the alcohol test, castor oil being entirely dissolved by its own volume of alcohol. At the present time castor oil is sold for about the same price as lard oil; consequently, there can now be no object for adulterating with this substance.

## CATECHU.

SYN. *Terra Japonica, Gambier, Cutch, Cutt.*

THE number of the kinds of catechu is very great, but it generally occurs under two forms in our mar-

ket; either in cubical masses of about an inch square, agglutinated together, of a dark-brown hue externally, and of a pale brick-color internally, the fracture being dull and earthy (this variety is styled in commerce *Terra Japonica* or *Gambier*), or in large lumps of a very dark-brown, almost black color, the fracture being shining and resinous, and these lumps being covered with large leaves. This variety occurs in commerce under the name of *Cutch*. But a detailed description of the various catechus may be found in Christison's Dispensatory.

Catechu has a powerfully astringent taste, slightly bitter and afterwards obscurely sweetish, and is easily chewed into a pulp, free of sandiness. It does not dissolve completely in boiling water, but when of good quality is almost entirely soluble in alcohol.

Catechu is liable to several adulterations, the finer sorts with the *inferior*, and all with foreign substances, such as *starch*, *clay*, *ochre*, and *other earthy matters*, and *alum*. The presence of starch may be detected by tincture of iodine giving a blue precipitate with a cooled decoction. The inorganic impurities may be readily ascertained by igniting a weighed portion, and weighing the ashes.

The best test for catechu is a practical one. The dyer makes a small dye-bath, and judges of the goodness of the article from the depth of his colors. The tanner may tan a few scraps of hide in a bath made of a standard amount of the tanning materials, and thus obtain comparative results. It has been recommended to test catechu in a manner similar to that employed for galls. But the product

thus obtained is far from being pure tannin, and the amount of impure tannin obtained in this manner allows hardly any conclusion as to the amount of pure tannin contained therein.

### CAYENNE PEPPER.

SYN. *Capsicum*; *Chillies*; *Guinea Pepper*; *Spanish Pepper*; *Bird Pepper*; *Cockspur Pepper*; *Cherry or Berry Capsicums*.

ALL the varieties of capsicum have a faint odor, and a hot, burning taste; and the acridity is communicated to hot water, spirit, vinegar, and fixed oils. Powdered capsicum has more or less of a scarlet color, which fades upon exposure to light, and even finally vanishes.

Cayenne pepper is often adulterated with *common salt, red-lead, brick-dust, ochre, Indian meal, &c.*

To detect common salt, treat a portion with cold water, filter and evaporate. The salt will thus remain behind sufficiently pure to be detected by its appearance.

The appearance, quantity, and properties of the ashes left, after incineration of the pepper, will show whether there is any earthy adulteration or not. Indian meal is detected by boiling a portion in water, and after cooling testing for starch by iodine. See *Iodine Test* in the Appendix.

## CHARCOAL, ANIMAL.

SYN. *Purified Animal Charcoal; Carbo Animalis Purificatus.*

PURIFIED animal charcoal is a black powder, and, when incinerated with its own volume of red oxide of mercury, should leave only a scanty ash. It is prepared from various substances, such as bone-black (extracted with muriatic acid), blood, fluxed with potash and lixiviated with water and diluted muriatic acid, &c.

## CHEESE.

FOR adulteration of cheese, see *Annotto*.

## CHLORIMETRY.

CHLORIMETRY is the method of testing bleaching-powder for that amount of its chlorine which is available for bleaching purposes. Three different methods are generally pursued for this purpose. The first consists in ascertaining how much of the sample is required to bleach a certain amount of an indigo solution of a certain strength. This method is defective in this, that an indigo solution changes by keeping, and thus renders the results uncertain, or requires the frequent preparation of a fresh standard solution, which is very troublesome. The second consists in determining how much of the sample is required to convert a solution of arsenious acid of a standard strength into arsenic acid. This method gives ac-

curate results, but is a disagreeable one, on account of the handling of the arsenic, which less skilful or confident manipulators like to avoid. The third, Otto's method, is free from these objections, and also gives accurate results; we will therefore limit ourselves to the description of this method alone. It is based on the determination of the quantity of bleaching-powder necessary to completely convert a certain quantity of pure sulphate of iron into a per-salt. Thirty-nine parts of sulphate of iron require just five parts of chlorine for its oxidation.

The reagents required are a solution of ferri-cyanide of potassium (red prussiate of potash of commerce), recently prepared, and pure sulphate of iron in powder. As the latter is not found in commerce in such a state that it can be kept without rapidly absorbing oxygen from the air, and as its preparation is not generally known, we will describe it here. Heat one part of oil of vitriol, diluted with eight times its bulk of water, and one part of clean iron wire, cut into small fragments, until all disengagement of hydrogen ceases; filter the liquor while hot, and pour immediately into the solution common alcohol so long as it continues to throw down any crystalline precipitate. Collect this precipitate on a filter, and wash it with alcohol several times, until the filtered liquor ceases to produce any reaction on litmus-paper, and the alcohol remains as concentrated as it was previously to being used. Dry the powder on a brick, and subsequently more perfectly by pressing it between blotting-paper. Keep it in a well-stoppered bottle.

To perform the test, dissolve thirty-nine grains of this sulphate of iron in about two ounces of water, and add about a dram of oil of vitriol. Then introduce fifty grains of the bleaching-powder under examination into a small porcelain mortar provided with a lip, and grind it to a thin paste, with a little water, and add gradually more water until the volume of the mass reaches about one fluid ounce. Pour this liquor into a graduated glass cylinder, a hundred or a thousand divisions of which will contain about two or three fluid ounces. Rinse the mortar repeatedly with small quantities of water, and add the rinsings to the rest of the liquor, until the graduated cylinder is filled with liquor to 100 or 1,000. Close the mouth of the cylinder with the thumb, and mix the liquor thoroughly, by shaking. Add this solution gradually to the acid solution of sulphate of iron, until the latter is completely converted into a per-salt.

This point is determined by testing with red prussiate of potash, in the following manner. Transfer a drop of the mixture, by means of a glass rod, on to a piece of white porcelain, and then add to this a drop of a solution of red prussiate; if the sulphate of iron is not completely oxidized, a blue precipitate will be produced; but as soon as it is converted into a per-salt, the blue precipitate will no longer take place, but the drop on the porcelain will assume merely a greenish or brown coloration.

This test must, of course, be frequently repeated, so as to determine when exactly enough of the bleaching-powder has been added to the sulphate of

iron. A good guide for knowing when about enough has been added is the odor of the liquid. The experimenter will find, on adding the bleaching-powder to the acid solution of iron, that its chlorine is evolved by the sulphuric acid. At the commencement of the operation, this chlorine will be rapidly consumed by the sulphate of iron, and the odor of the liquor will consequently disappear rapidly. The nearer the point of saturation approaches, the longer it will take before the chlorine produced by each successive addition of bleaching-solution will disappear.

As soon as a sufficient quantity of bleaching-solution has been added, observe the amount poured from the graduated glass. The quantity thus ascertained will correspond exactly to five grains of chlorine.

It will be well for the less experienced operator to make the experiment twice, to see whether his results agree in both instances, thus assuring himself of the accuracy of his manipulations.

The calculation of the results is very simple. If the 50 grains of bleaching-powder had been diffused in 1,000 divisions of the cylinder, every 20 divisions would then correspond to one grain of bleaching-powder. Let us suppose that 360 of these divisions had been consumed in peroxidizing the iron. In this case  $\frac{360}{20} = 18$  grains of bleaching-powder would contain 5 grains of chlorine; or  $100 = \frac{5 \times 100 \times 20}{360} = \frac{10000}{360} = 26.6$  per cent. of chlorine. Should the manipulator not own a graduated cylinder, he can do without it, if he possesses good graduated ounce and minim glasses. In order to determine the correctness of the glasses, see *Alka-*

*limetry.* Pour into a cylindrical glass jar 2 ounces and 20 minims of water, equal to 1,000 minims, and mark its level by making a scratch with a file or diamond, or by means of a strip of paper pasted on the outside of the jar. Then pour in the mixture of bleaching-lime till it reaches that mark, and perform the experiment in the same way as was done with the graduated cylinder. When enough of the solution has been used, mark the level of the remaining liquor by a strip of paper pasted on the outside of the jar; then empty it of its contents, and clean it. Pour in water again to the latter mark, and observe how many minims are wanted to fill the cylinder thus far. The quantity of liquor consumed in the experiment will then be determined by subtracting this number from 1,000.

If 50 grains of the bleaching-powder under examination should contain less than 5 grains of chlorine, that is 10 per cent., that quantity will not completely peroxidize 39 grains of sulphate of iron. A second or a third 50 grains is then treated as above, and added until the iron salt is completely peroxidized. If 1,640 divisions of the bleaching-solution have been consumed, the bleaching-lime will contain  $\frac{10000}{1640} = 6.1$  per cent. of chlorine. If 2,620 minims had been used, it would contain  $\frac{10000}{2620} = 3.9$  per cent. of chlorine.

The bleaching-powder of the best manufacturers contains from 25 to 27 per cent. of chlorine; it not unfrequently, however, occurs in commerce containing 10, or even less than 10 per cent. of chlorine.

## CHLOROFORM.

SYN. *Chloroformum.*

THIS anæsthetic agent should have a pleasant, ethereal odor, and a warm, sweet taste. It should not be blackened by oil of vitriol, and when dissolved in alcohol it should not precipitate a solution of nitrate of silver. When physicians desire to use the alcoholic solution, and not the chloroform itself, they should prepare it themselves, or obtain it from a responsible apothecary, as the qualities of the alcoholic solution are not so readily judged of as those of the chloroform alone.

"Soubiran tests the purity of chloroform, by ascertaining whether it will sink in a mixture of equal parts of concentrated sulphuric acid and water; L. Kessler has called attention to its adulteration with ether, and remarks that chloroform, when agitated with Soubiran's test-liquid, does not diminish in volume, while that which contains alcohol decreases. According to Mialhe, pure chloroform remains transparent when poured into water, while that which contains alcohol becomes opalescent. According to Cottel, that which contains alcohol is colored green by chromic acid, or by bichromate of potassa and sulphuric acid, while pure chloroform is not affected by this treatment." (Liebig's Annual Report of the Progress of Chemistry.)

## CHROME-GREEN, COPPER-GREENS, AND ARSENICAL COPPER-GREENS.

CHROME-GREEN is a mixture of chrome-yellow and Prussian blue, and generally contains more or less barytes. The value of it for painters' use is best judged of by the common method of the painters, from its brilliancy, and the body which it makes with oil.

It can be distinguished from the copper-greens by heating it gently with moderately concentrated muriatic acid, filtering, and immersing a piece of iron in the solution; when copper will be deposited upon the iron, if present.

Arsenical copper-greens may be distinguished, by submitting this same solution to Marsh's test, which see.

## CINCHONA-BARK.

SYN. *Peruvian Bark; Jesuit's Bark; Cinchona.*

ACCORDING to botanists, there are a great many varieties of cinchonas, from which the barks of commerce are derived; but in the trade they are usually distinguished as *yellow, pale, gray, and red* barks; also by the names of *Calysaya, Loxa, Maracaybo, and Carthagena* barks, &c. Those barks which come from the western coast of South America are held in the highest repute, while those from the northern Atlantic coast are regarded as inferior.

It is beyond the scope of the present work to de-

scribe the physical appearances of the different varieties of the barks, and in fact it would be hardly possible to describe them so that they might be recognized without standard samples being at hand with which to compare them.

Good Peruvian bark should have a slight odor; the stronger this is, without being disagreeable, so much the better the bark. The taste should be bitter, and is sometimes slightly acid,—this acid taste I have observed more particularly in the pale Maracaybo bark,—and should not be nauseous, offensive, or very astringent. But the only perfectly reliable test for Peruvian bark is to determine the amount of *quinine* and *cinchonine*, and perhaps *aricine*, contained in it.

Dr. Linck has furnished me with the following process for determining the value of Peruvian bark:—  
“Take half an ounce of the bark ground moderately fine, mix it with water in a porcelain dish to the consistency of a thin cream, add twelve grains of oil of vitriol, and mix well together. Digest over a water-bath from four to six hours, with occasional stirring, and add water as fast as it evaporates. Strain through cotton cloth, restore the powder to the dish, wash the cloth in a little clean water, and pour this wash-water into the dish; then add as much more water as is required to cover the bark, and digest over the water-bath for an hour. In the mean time pass the first solution through a paper filter. Strain the second infusion through the same cotton cloth, and the same paper filter. Digest the bark with a fresh quantity of water for half an hour, strain, and filter

again. Repeat this so long as the infusions have a strong bitter taste. A little water only should be taken at a time, and the infusions should be frequently repeated, so as to get all the virtues of the bark in as small a volume as possible. Add all these infusions together, and stir in some milk of lime, until a decided alkaline reaction is produced by the mixture on turmeric paper. Collect the sediment upon a filter, and dry it at 212° F. Boil repeatedly with alcohol, decant and filter the tinctures as long as they taste bitter. Add sulphuric acid to the filtrate until it has a very slight acid reaction, and then about two drams of pure water. Evaporate to one ounce, filter through a very small paper filter, to separate any resin which may be present. After having neutralized the solution as exactly as possible with ammonia, evaporate again to about half an ounce, and set it aside to crystallize. Disulphate of quinine, which, with sulphate of cinchonine, is contained in this solution, will then begin to crystallize, if it is present in a large proportion. If crystals do not appear, the liquor must be concentrated still further. If after considerable concentration the neutral liquor still refuses to deposit crystals of the characteristic appearance of the quinine salts, the absence of quinine must be inferred. If the salt appears, however, it is crystallized out carefully and collected on a small weighed filter (of Swedish or other fine filtering-paper), washed with cold water, then dried, and weighed. The filtrate precipitated with ammonia yields cinchonine, which is also collected upon a filter and weighed."

Analyses made by Dr. Linck, according to the above process, gave the following results:—

	Disulphate of Quinine.	Cinchonine.
Flat Calysaya bark,	1.25 per cent.	4.0 per cent.
Flat Charquedilla bark,	3.34 “	0.0 “
Flat Manchada bark,	2.10 “	0.6 “
Pale Maracaybo bark, I.	1.75 “	Not determined.
“ “ II.	0.00 “	2.0 per cent.
Red bark from Guayaquil,	0.60 “	0.95 “

The first four barks were imported from Valparaiso, and are presumed to have been government monopoly barks; the names are given as invoiced at Valparaiso.

Soubeiran states, that "M. Guillermond the younger has proposed a very good method of testing Peruvian bark, which allows of the operation being finished in one day. The bark is reduced to powder, and exhausted by displacement by means of alcohol of 80 per cent. For every two pounds of bark, one ounce of powdered quicklime is added to the alcoholic liquor, and it is repeatedly shaken. The calcareous precipitate is separated by filtration, and sulphuric acid is added to the filtrate in just a sufficient quantity to communicate to it an *exceedingly slight* acid reaction; distil, filter to separate a little resin which is precipitated, and concentrate the filtrate to obtain crystallized sulphate of quinine."

According to the same authority, the Peruvian barks of commerce give the following percentages of sulphate of quinine and of cinchonine:—

	Per Cent.
Calysaya bark, without epidermis, 3 to 3.2 of sulphate of quinine.	
“ “ with epidemis, 2.4 “ “ “	
Gray Loxa bark, 1.2 to 1.6 “ “ cinchonine.	
Gray Lima bark, 1.2 “ “ “	

	Per Cent.
Bright red bark,	$\left\{ \begin{array}{l} 1.6 \text{ of sulphate of quinine,} \\ .8 \quad " \quad " \quad \text{cinchonine.} \end{array} \right.$
Pale red bark,	$\left\{ \begin{array}{l} 1.2 \quad " \quad " \quad \text{quinine,} \\ .8 \quad " \quad " \quad \text{cinchonine.} \end{array} \right.$
Spongy Carthagena bark,	.3 to .4    "    "    "

Peruvian bark is liable to adulteration with false barks, inferior Peruvian barks, and barks from which the quinine has been extracted ; and more especially is the powder liable to adulteration. The false barks are said to have a disagreeable taste, but the surest and simplest method of determining the value of bark is to test it for quinine and cinchonine by the methods just given.

### CINNAMON.

#### SYN. *Cassia.*

Two varieties of barks occur in commerce under the name of cinnamon. *Real* or *common* cinnamon comes from Ceylon ; and *Chinese cinnamon*, or *cassia*, from Canton. There is also another variety of cinnamon called *Cayenne cinnamon*. I have recently, also, seen a very coarse cinnamon imported from *Manilla*, many of the pieces being from a quarter to half an inch thick.

The Ceylon cinnamon is the most esteemed, and deservedly so, as its taste and odor are more delicate. It should be very smooth and thin, about the thickness of drawing-paper, and should break in splinters, and not in short cross-pieces.

Cassia-bark resembles cinnamon-bark, but it is not so thin or smooth, does not break splintery, but short, and the odor and taste are not so delicate.

The finer variety of Cayenne cinnamon is said to resemble very much the Ceylon cinnamon.

*Cassia buds*, which are gathered from the Chinese cinnamon, have the pleasant cinnamon odor, and bear a slight resemblance to cloves.

#### CITRIC ACID.

SYN. *Concrete Acid of Lemons.*

CITRIC ACID occurs in rhomboidal prisms, is white, inodorous, and has an excessively sharp, sour taste. It dissolves in three fourths of its weight of cold water, and in half its weight of boiling water. It is soluble in alcohol. “It precipitates baryta and not lime from their solutions, which distinguishes it from tartaric acid.” (Soubiran.)

It is liable to be adulterated with *lime* and *tartaric acid*, and also to be contaminated with *sulphuric acid*. Sulphuric acid may be determined by chloride of barium. Lime, or any inorganic impurities, are determined by incineration, and this process is assisted when it is incinerated with red oxide of mercury. Tartaric acid is indicated by a crystalline bi-tartrate being formed on the addition of muriate of potash to a strong solution in water.

#### CLOVES.

SYN. *Caryophyllus.*

THE clove consists of the tubular calyx of the flower, with four spreading divisions at the top, surmounted by a knob, which is the unexpanded corolla.

Good cloves should be large, plump, of a dark brown, nearly black color, and the knob should be present; they should give out oil when squeezed with the nail. They have a pleasant, penetrating, peculiar odor, and a hot, acrid, aromatic taste.

The finest cloves come from the Moluccas, and others, which are paler and contain less oil, from Cayenne, the West Indies, and South America. "The best variety of the Amboyna cloves is smaller and blacker than the other varieties, very scarce, and, as a mark of preëminence, is termed the royal clove." (McCulloch.)

Good cloves are sometimes adulterated by mixing them with those from which the oil has been extracted; but these are weaker than the rest, and have a paler color; and whenever they are shrivelled, or have lost the knob, or are light and broken, or are nearly odorless and tasteless, they should be rejected. As cloves are very hygroscopic, a considerable addition may be made to their weight by keeping them in a damp place; this may be determined by placing a weighed portion under a bell-glass by the side of a vessel containing concentrated sulphuric acid, and letting it remain there for twenty-four hours. The loss in weight indicates the amount of water.

#### COBALT, OXIDE OF.

THERE are two oxides of cobalt, the protoxide and peroxide, which are used for staining porcelain and glass. The first is of an *ash-gray* color, and the latter is *black*.

Oxide of cobalt is most frequently contaminated with *silica*, *arsenic*, *magnesia*, *alumina*, *manganese*, *iron*, &c.; but as the testing of these substances in cobalt requires a special knowledge of qualitative analysis, I must refer those who have occasion to make such an analysis to the works of Fresenius, Wills, &c.

The solution of pure oxide of cobalt ought not to give any precipitate with sulphuretted hydrogen, nor with ammonia to which a solution of sal ammoniac has been added.

#### COCHINEAL.

##### SYN. *Coccus Cacti*.

COCHINEAL, as occurring in commerce, is a female impregnated insect, having a roundish plano-convex body, rough, and transversely wrinkled on the back. Each insect is scarcely two lines in length. Two sorts occur in commerce, *silver* and *black* cochineal. They are both of a deep purple color, but externally the silver cochineal has a white bloom, while the black variety is without bloom. These are of about equal value in a commercial point of view. But there are two other varieties of less esteem, which are seldom met with; namely, the *wild* cochineal, which are very much smaller insects, inclosed in a white or cotton-like substance, and the *Granilla* cochineal, consisting of young insects and the *debris* of the old ones.

Cochineal imparts a red color both to water and alcohol.

This insect can hardly be adulterated, but it is stated that the silver bloom is sometimes imitated by shaking the insects with *sulphate of baryta* or *talc*. This fraud is easily detected by the absence of downiness before the microscope.

The tinctorial value of cochineal may be ascertained by comparing the depth of shade which a certain weight of the sample under examination will communicate to alcohol or water, with that given by what is known to be a standard article.

Cochineal is also esteemed according to the excess of interior matter over the skin, or, in other words, according to its plumpness.

#### COD-LIVER OIL.

##### SYN. *Oleum Morrhuae.*

THIS oil, as usually prepared for medicinal purposes, is more or less yellow, has a fishy odor, but unlike that of whale oil, and a peculiar taste, very much resembling the taste of sardines which are put up in oil. This taste, when decided, is a good test of the purity of the oil. It should not have any taste of whale-oil, with which it is said to be sometimes adulterated. Some physicians prefer the dark-colored oil, which has a repulsive taste and smell, and the genuineness of which is hard to be judged of. Iodine is a small, but thought to be an essential, constituent of cod-liver oil. If it was ascertained how much the different kinds of genuine cod-liver oil differ in the amount of iodine which they contain, this might afford a chemical criterion for the genuineness of a suspicious article.

## COLCHICUM.

SYN. *Meadow Saffron.*

THE colchicum bulb is about the size of a small apricot, but it occurs in the shops in dry, transverse slices, which should be firm, of a grayish-white color, and notched only on one side. It is sometimes sliced vertically. A fresh-scraped surface, moistened with vinegar, and then with tincture of guaiacum, should be turned blue.

The seeds are small, rough, roundish, and dark-brown. Both the bulb and the seeds are odorless, but have a bitter, acrid taste.

## COLLODION.

IT is a colorless, syrupy liquid, and when applied to the skin, the fluid portion immediately evaporates, leaving behind a thin pellicle. Collodion should have no acid reaction, and should be of the proper consistency. The dried substance should burn like gun-cotton itself.

## COLOCYNTH.

SYN. *Bitter-apple; Coloquintida; Colocynthis.*

COLOCYNTH is a globular fruit, with a yellow rind, about the size of an orange; but it is generally imported deprived of its rind by peeling. The pulp of the dried fruit is the officinal part. The best colocynth is white, spongy, and porous, of middling size, and without seeds. The common sort contains the

seeds. Colocynth pulp is not liable to adulteration; but if it is grayish or brownish, and is of the larger fruit, it is of inferior quality.

#### COLOMBO-ROOT.

SYN. *Colomba*; *Calumba*.

COLOMBO-ROOT occurs in flat, circular pieces, from half an inch to three inches in diameter. The flat surfaces are concave, and traversed by darker rays. The powder has a greenish-yellow tint. The pieces consist of a thin brown, rugose epidermis, a thick yellowish inner bark, and of a light grayish-yellow internal ligneous structure. Colombo has a feeble aromatic odor, and a strong bitter taste, without acrimony or astringency.

It is said that the root is sometimes adulterated with *briony-root*, and with the root of the *Frasera Walteri*. The former is at once detected by its disagreeable, bitter, somewhat acrid taste; the latter, by its infusion becoming dark green on the addition of sesquichloride of iron, the infusion of colombo not being affected by this test. A false colombo occurs in French commerce, which is known by containing no starch, while the genuine root does contain it. See *Iodine and Starch Test*.

#### CONFECTIONERY.

UNDER this head are included *sweetmeats*, *jellies*, *bonbons*, *lozenges*, *candy*, &c., which are all liable to serious contaminations. The noxious substances

that may be added are preparations of *arsenic*, *copper*, *mercury*, *zinc*, *lead*, *chrome*, *gamboge*, &c.; but if those who consult this work are unacquainted with the method of testing these impurities, I would refer them to special works on chemical analysis, but more particularly to an experienced analytical chemist. It is beyond the scope of this volume to treat the subject in a manner at all satisfactory. The metallic substances may be separated from each other and detected by the methods given in the Appendix, and by others referred to under appropriate heads in the body of the work.

## COPAIBA.

SYN. *Copaiva*; *Copivi*; *Balsam of Copaiva*.

COPAIBA is a transparent, oily liquid, of a pale-yellow color. It has a strong nauseous odor, and a permanent, disagreeable taste. Specific gravity, .950 to .960, becoming denser by age.

According to Gerber, recent copaiba gives 41 per cent. of volatile oil, 51 per cent. of hard yellow resin, soft resin, and water. It is insoluble in water, but soluble in alcohol, ether, and the fixed and volatile oils. It dissolves magnesia and its carbonates, and forms with them, after a few hours, a translucent mass, of a sufficient consistency to form into pills.

Balsam of copaiva is adulterated, sometimes with *castor oil*, and sometimes with *turpentine*. Soubeiran says that there are many ways of recognizing the falsifications with castor oil, but that the two following methods are the best.

1. Boil the copaiba for a long time in water, to expel the volatile oil: if pure, a resin is left, which becomes dry on cooling. An adulteration with any other fixed oil may be detected by alcohol of 95 per cent., which will not dissolve them.

2. Pour one or two drops of the balsam upon paper, and heat it to volatilize the volatile oil. If the balsam is pure, a homogeneous and translucent spot remains; but if the balsam is contaminated with a fixed oil, the resinous spot is surrounded with a fatty areola.

When copaiba is adulterated with turpentine, Soubeiran also says, it is of difficult detection; the fraud may be recognized by the odor, and this may be rendered more obvious by pouring the balsam upon a warm iron plate. Besides this, when copaiba is adulterated with turpentine, it is more viscous, and adheres to the sides of the vase in which it is shaken.

Here we may add the test proposed by Planche:— “Pure copaiba agitated with solution of ammonia, 0.965, becomes clear and transparent in a few moments; but remains turbid, if castor oil be present.”

When rubbed upon paper and dried, it leaves an apparently greasy stain; but this differs from that of oil, in admitting of being written over with common ink.

#### COPAL.

SYN. *Gum Copal.*

COPAL is a resin, and is imported from the East Indies, South America, and the western coast of Africa. It occurs in irregular roundish or flat masses,

is of a light straw color, transparent internally, the surface being slightly opaque. It is very hard, with a lustrous fracture, inodorous and tasteless, insoluble in common alcohol, partially soluble in absolute alcohol and in oil of turpentine, but entirely soluble in ether. Sometimes it is yellow or brownish, and mixed with insects, &c. When of good quality, it is too hard to be scratched by the nail, and has a conchoidal fracture.

It is imported covered with sand and earth,—*crude copal*,—from which it is cleansed by an alkaline solution, which dissolves the copal, and by scraping,—*scraped copal*. Copal is sometimes adulterated with *anime* or *dammar resin*; but the latter may be detected by being entirely soluble in strong alcohol. Dammar is also soluble in pure oil of turpentine.

#### COPPER, ACETATE OF.

##### VERDIGRIS.

SYN. *Subacetate of Copper; Basic Acetate of Copper; Impure Diacetate of Copper; Ærugo; Cupri Subacetas.*

##### PREPARED VERDIGRIS.

SYN. *Acetate of Copper; Crystallized Verdigris; Distilled Verdigris; Crystals of Venus; Cupri Acetas.*

THE verdigris of commerce is a basic salt; but the prepared verdigris is a neutral salt.

There are two kinds of commercial verdigris, the *green* and the *blue*. The green salts contain less

acid and more base than the blue. Both articles, on being treated with water, are decomposed into more basic, insoluble salts, and into a more neutral solution.

The verdigris of commerce generally contains from two to five per cent. of impurities, such as *metallic copper, earthy matters, and husks and stones of grapes*. According to Normandy, "this article, which is extensively used by painters and dyers, and in medicine, is often adulterated to an enormous extent with *chalk* and with *sulphate of copper*." Prepared verdigris is probably never adulterated.

Verdigris occurs in masses, of a pale-green color, consisting of minute silky crystals; sometimes it is of a bright blue, and has a strong coppery taste. Normandy says, that "the buyers generally judge of its value by the brightness of its color, and by its dryness; by rubbing it in the palm of the hand with a little water or saliva, it should form a smooth paste, free from grittiness." The tests of its purity are dilute sulphuric acid, acetic, nitric, and muriatic acids, or ammonia, which should almost entirely dissolve it, not above five per cent. of impurity being left. Water but partially dissolves the verdigris of commerce, while crystallized verdigris is entirely soluble in it. The latter, also, should always come in clear crystals of a deep blue color.

Metallic copper, earthy matter, and refuse of grapes may be detected by their insolubility in ammonia; sulphate of copper, by adding to the solution in muriatic acid a solution of chloride of barium, which will cause a white precipitate of sulphate of baryta,

if this sulphate is present. Chalk may be detected by effervescing on the addition of an acid, or by remaining undissolved with ammonia.

The principal tests for acetate of copper are *sulphuric acid, ammonia, and a piece of polished steel*. The former poured upon the salt causes the odor of vinegar to be emitted, the second added to the solution causes a splendid blue coloration, and the latter, when placed in the solution, becomes covered with a layer of metallic copper.

#### COPPER, SULPHATE OF.

SYN. *Blue Vitriol; Blue Stone; Vitriol of Copper; Roman Vitriol; Cupri Sulphas.*

BLUE VITRIOL occurs in the shops in crystals of a fine blue color. It is odorless, but has a styptic, metallic taste. It is efflorescent, and becomes greenish and crumbles on exposure to warm and dry air. It is soluble in water, and insoluble in alcohol. Ammonia precipitates it from its solution, and when added in excess dissolves it, forming a beautiful azure-blue color. This is an exceedingly delicate test for the salts of copper.

This salt is not liable to adulteration, but may contain *sulphate of iron or of zinc*. A solution of it treated with ammonia will indicate the former by an insoluble reddish precipitate remaining in the liquid, and the latter may be detected by giving a white precipitate with ammonia, in a solution from which the copper has been thrown down by sulphuretted hydrogen.

## CREOSOTE.

SYN. *Kreasote*; *Creasoton*; *Creasotum*.

PURE creosote is a colorless, transparent, oily-looking liquid, and has a smoky odor, and an escharotic taste. Its density is 1.066. It is liable to be impure, from faulty manufacture, or by the fraudulent addition of some fixed oil.

But it may be regarded as pure if it is colorless, and remains so when exposed to solar light; if it has a specific gravity of 1.066; if it is entirely soluble in its own weight of acetic acid; and if a drop of it placed on white filtering-paper, and heated for ten minutes at the boiling point of water, leaves no translucent stain.

## CUBEBS.

SYN. *Tailed Pepper*; *Cubebæ*.

CUBEBS are small, dark-colored berries, generally with their stalks attached, which prolong themselves over the berries, forming a sort of network in appearance. Each of these berries contains within this outer shell a loose seed. They have an aromatic, peppery odor, and a hot, peppery, somewhat camphoraceous taste. They deteriorate by age, and should not be pulverized except when required for use.

They are frequently adulterated with *different berries*, which may be recognized by the appearance and taste. One of our most experienced apothecaries has told me, that such fine cubebs as were formerly met with do not now occur in the market.

“ Their powder is said to be sometimes adulterated with that of pimento.” (Wood and Bache’s Dispensatory.)

#### CUDBEAR.

SYN. *Persio*; *Powdered Archil*.

THIS is prepared in a similar way with archil, except that it is dried and powdered. It is a powder of a deep violet color, and of a peculiar odor. It may be tested in the same way that archil is, which see.

#### DRAGON'S-BLOOD.

SYN. *Sanguis Draconis*.

THIS is a resinous substance occurring sometimes in drops, or in small balls of the size of a pigeon's egg, sometimes in rods or sticks, and sometimes in cakes. The latter is the least esteemed. Its color in mass is of a dark-brown red, and its powder is of a bright crimson; “if it be black, it is worth little.” It has a shining fracture, and is insoluble in water, but dissolves readily in alcohol, ether, and oils. It is very apt to be adulterated. It should not be acted upon by water, or crackle in the fire, without burning. Genuine dragon's blood readily inflames. When heated, it smells like benzoin, it containing benzoic acid.

#### ELATERIUM.

SYN. *Wild* or *Squirting Cucumber*.

THE best elaterium is in thin light and friable

fragments, of a pale greenish-gray color, and of an intensely bitter taste; the pieces generally bear the impression of the muslin on which they have been dried. There is an inferior sort of elaterium, of a blackish or dark-green color. The active principle of this medicine is *elaterin*, which should constitute at least fifteen per cent. of elaterium, though this sometimes contains as much as twenty-six per cent., while black elaterium does not give above six per cent.

As elaterium varies so much in strength, the best way to ascertain its goodness is to determine the amount of elaterin it contains. This is done by exhausting the elaterium thoroughly with boiling rectified spirit, concentrating this tincture, so long as no separation takes place, and then pouring it while hot into a boiling weak solution of potassa. On cooling, the elaterin crystallizes in colorless satiny crystals.

#### ELEMI.

ELEMI is a resinous substance, and has an agreeable terebinthinate odor, mixed with that of fennel and lemon, and a bitter, aromatic taste. It has a yellow or greenish semi-transparent appearance, and softens in the mouth, and becomes adhesive. It is very fragrant also when burnt. Elemi is adulterated with *resin*, *turpentine*, &c., and, according to Cooley, a factitious kind is prepared by melting together Canada balsam, yellow resin, and oil of juniper and of fennel. But the characteristics given above are probably sufficient to indicate when it is genuine.

## ERGOT.

SYN. *Spurred Rye; Ergota; Secale Cornutum.*

ERGOT consists of angular or round bodies, slightly curved like the spur of a cock, and marked commonly with two longitudinal furrows. It is of a dark violet color externally, and dull white internally. The odor is heavy and somewhat fishlike, and the taste is obscurely acrid, and sweetish. It breaks with a clear transverse fracture, is lighter than water, and burns with a clear flame.

Ergot is sometimes spoiled by the interior being devoured by insects; and is frequently spoiled by age, and exposure to the air, in this case swelling up, and becoming black, limber, and foetid. It is stated in the English Dispensatories that ergot is liable to adulteration with *plaster of Paris* and *common paste*, artfully colored. By boiling the specimen in water, the paste will dissolve, and the inorganic matter will be left behind on incineration. Ergot ought not to be kept in powder long, but must be powdered shortly before dispensing it.

## ETHER.

SYN. *Sulphuric Ether; Æther Sulphuricus.*

ETHER should have a perfectly neutral reaction, should possess a pure ethereal odor, should yield no residue on evaporation, and on mixing it with pure water it should not become milky. For common medicinal purposes it is not necessary that it be perfectly free from water and alcohol. The United States Dispensatory allows it to possess a specific gravity of

.750, that of pure ether being only .715. Alcohol, however, is added to such an extent that the purchaser should always test for it. Pure ether is soluble in about seven and a half times its own bulk of pure water. If alcohol be present in large quantities, it will be much more soluble. Thus, if 21 minims of water be shaken in a minim-glass with 21 minims of ether, the lower layer of liquid (water) will, after a few moments, rise to about 24 or 25 minims. If more space than this is taken up by the lower layer, it indicates the presence of alcohol, or water. Another very good test for the purity of ether is the stability of its boiling-point. Pour two ounces of ether into a small tubulated retort, through the neck of which a thermometer has been inserted by means of a perforated cork, and let the thermometer reach very nearly to the bottom of the retort. Commence heating in a water-bath. The ether will begin to boil when the thermometer indicates about 98° F. If the ether be pure, it will keep boiling at that temperature, until the whole is evaporated. If impure, the boiling point will gradually rise. As soon as the boiling point has risen one or two degrees, let the distillation be stopped. The quantity of liquid left behind will allow of a judgment as to the quantity of water and alcohol the ether contained. When required for inhalation, the ether should be perfectly concentrated, and free from all impurities. A handkerchief moistened with ether should *not*, after the evaporation of the ether, *retain a nauseous odor*. The specific gravity should not be over .720 or .730. The alcohol used for making the ether should be free of fusel oil.

If these points were always well attended to, much of the unpleasantness following the inhalation of ether would be avoided.

"The manufacturer's price for this article is twenty-five cents per pound, which seems to us rather too cheap for an article made from perfectly pure alcohol, and of high concentration."

#### FLAXSEED.

SYN. *Linseed; Lini Semen.*

FLAXSEED is often mixed with other seeds, from the weeds, &c. which grow among the flax. As these false seeds are often of an irritating nature, they may produce baneful effects in sickness. Indeed, I once had a patient sick with inflammation of the stomach, for whom I ordered a drink of flax-seed tea. The drink caused severe burning in the stomach, and on examination I found the flaxseed to be mixed with other seeds, which were irritating to the taste. These seeds can all be distinguished by inspection.

#### FLOUR.

SYN. *Wheat Flour; Triticum Hybernum; Farina.*

FLOUR is white, inodorous, and nearly insipid. It consists of the following constituents:—

Water,	.	.	.	.	from 10 to 17	per cent.
Gluten,	.	.	.	.	"	9 to 14
Starch,	.	.	.	.	"	62 to 71
Sugar and gum,	.	.	.	.	5	"
Bran	.	.	.	.	from 1.20 to 2.30	"
Inorganic residue,	.	.	.	.	0.80	"

The most important constituents to determine are the water, gluten, starch, and inorganic residue, which may easily be done as follows.

The water is determined by the loss in weight caused by drying it at 212° F.

The gluten and starch, by washing a sample of the flour on a piece of muslin at the same time kneading it with the hand, and this to be continued until the liquid which runs through the cloth becomes clean. The gluten which remains on the cloth must then be dried and weighed, and the starch which passes through with the filtered liquid must be allowed to settle, when the clear liquid may be decanted, and the starch collected on a filter, dried, and weighed.

The inorganic residue is determined by the amount of ash left after incineration. Fresenius states that flour should not contain over one and a half per cent. of inorganic matter, any thing above this being an adulteration.

These four factors being known, a good guide is had as to the quality of the flour. The value of flour chiefly depends upon the greater quantity of gluten and the lesser amount of water contained in it.

Mitchell says, "The substances employed in the adulteration of flour are the following: potato-starch (much employed in France), bean, pea, and rye flour, chalk, burnt bones, powdered flints, and plaster of Paris."

Earthy matter, and even potato-starch, can be detected by the greater weight of the flour, if those substances are contained in it in large quantities;

pea and bean flour, by the odor which they emit when mixed with boiling water. The quality of flour is best ascertained by making it into bread. The quality of the bread shows whether some other cheaper kind of flour has been mixed with it. See *Bread*.

#### FOXGLOVE.

SYN. *Digitalis*.

FOXGLOVE is not liable to adulteration, but is sometimes improperly cured, or has been kept too long. The powdered leaves should have a bright, green color, and should possess a faint narcotic odor and a nauseous and acrid taste. The dried leaf is of a dull green color, and has a whitish down on the under surface.

#### FUSEL OIL.

SYN. *Oil of Potatoes*; *Oil of Grain Spirits*; *Amylic Alcohol*; *Hydrate of Oxide of Amyl*.

FUSEL or fousel oil is a colorless, limpid, oily liquid, of a disagreeable odor, and of an acrid taste. Its density is 0.818 at 60° F. It soils paper like the essential oils, but the spot readily vanishes as the oil volatilizes. It is insoluble in water, but is soluble in every proportion in alcohol and ether.

#### FUSTIC.

SYN. *Yellow-Wood*; *Old Fustic*.

THIS yellow dye-wood should be in large, compact billets of a yellow color, unmixed with red.

The interior often contains a yellowish crystalline substance, which constitutes, according to M. Chevreul, the coloring matter of the wood. A decoction of this wood in ten parts of water is of a lively orange-yellow color, and preserves its transparency while warm, but deposits *morin* on cooling. This decoction is inodorous, and has a bitter and slightly astringent taste.

### GALBANUM.

THIS gum resin occurs both in tears and lumps. The tears are about the size of a pea, and are usually agglutinated in masses of a pale greenish-yellow or reddish color, and are translucent. There are two varieties of galbanum in lumps, one consisting of tears united together by an *agglutinating material*, and inferior to the above, and the other a very coarse article of a brown color, a weak odor, and containing few or no tears, and mixed with sand, chips, straw, and other impurities. But pure galbanum is entirely soluble in diluted alcohol, while the impurities are insoluble.

### GALLIC ACID.

SYN. *Acidum Gallicum.*

GALLIC ACID occurs in silky crystals, sometimes perfectly white, but most generally tinged with a yellowish color. For solution, it requires one hundred parts of cold water and three parts of boiling water. It has an astringent taste. It may be separated and distinguished from tannic acid by a solution of gelatine, or by animal skin, which precipitate the latter acid, but not gallic acid.

Sesquichloride of iron produces in solutions of gallic acid a dark-blue precipitate, and green vitriol a black precipitate.

### GALLS.

SYN. *Nut-galls; Gallæ.*

GALLS are excrescences produced by an insect on the leaves and shoots of several species of oaks. There are three varieties in commerce, the *blue*, *green*, and *white* galls. The two former are also often designated as *black* or *Aleppo* galls.

It is very easy to judge of galls by their physical characters. The best are heavy, small or medium sized, blue or green, unpierced by an insect-hole ; while the inferior sorts are whitish, light, and are pierced with a round hole, and nearly hollow within. All varieties are more or less tuberculated on the surface, but the finer sorts have sharper points. The best galls yield from forty to sixty per cent. of tannin, on treatment with ether in a displacement apparatus.

White galls are sometimes made to imitate the superior blue galls, by impregnating their surface with sulphate of iron ; but this fraud can easily be detected by treating them with muriatic acid, which will remove the iron color, but will leave untouched the natural color of the galls.

## GAMBOGE.

SYN. *Gambogia*; *Cambogia*; *Gammi Gutta*.

THREE sorts of commercial or Siam gamboge are found in commerce, *pipe*, *lump* or *cake*, and *coarse* gamboge. Pipe gamboge comes in cylindrical pieces, either solid or hollow. It is yellowish, greenish, dusty and striated externally, of a rich reddish-yellow color internally, and brittle, with a smooth, glistening, and conchoidal fracture. Lump gamboge is in irregular masses of a duller color, with a splintery, not shining fracture. Coarse gamboge differs principally from lump gamboge in containing more impurities. There is still another kind of gamboge mentioned by Christison as *Ceylon gamboge*, and is in flattish, round masses; but it is hardly an article of commerce.

Gamboge is almost entirely soluble in rectified spirit; and sulphuric ether completely dissolves out the resin, leaving the gum undissolved. It is entirely dissolved by the action, first of ether, and then of water. Pipe gamboge is the most esteemed, and should yield from 68 to 75 per cent. of resin. Lump and coarse gamboge are said for the most part to be adulterated with argilaceous substances and lignin, the former containing generally, according to Christison, about 11 per cent., and the latter from 15 to 41 per cent. of impurities.

Christison states that the Ceylon gamboge is a coarse-looking article, but that it is as pure as the pipe gamboge, and is equally fit with it for all medicinal and economical purposes.

To detect the presence of starch in gamboge, exhaust the powdered gamboge with ether, then boil the residue in water and test by the *Starch and Iodine Test*.

### GARANCINE.

THE tinctorial power of this substance must be tested for in the same manner as *madder*, which see.

### GENTIAN.

#### SYN. *Gentiana*.

THE root is the part of the gentian which is used in medicine, and occurs in pieces commonly a few inches long, seldom more than an inch in diameter, and split lengthwise if large. The epidermis is wrinkled, and of a brownish-yellow color; internally, the root is yellow and spongy. It has a slight aromatic odor, and a taste sweetish at first, but afterwards purely and intensely bitter.

The officinal species is said to be mixed with the roots of other gentians; but this adulteration seems to be of no very great importance, as they possess similar medicinal properties. A more serious fraud, or gross carelessness, has, however, been practised, that of mixing with the gentian-root *roots of belladonna, monk's-hood, or white hellebore*. They are fortunately to be easily distinguished by careful observation, as they do not have the yellow color internally, or the pure intensely bitter taste of gentian.

## GLYCERINE.

SYN. *Sweet Principle of Oils; Hydrate of Oxide of Glyceryl.*

IT is a syrupy and colorless liquid, having a sweet taste like sugar; it is miscible in all proportions with water and alcohol, but insoluble in ether. When heated, it gives off a most pungent and irritating odor of *acroleine*. Cooley says it may be obtained in an impure state, by hogsheads at a time, from the stearine-makers, and is evaporated and largely employed to adulterate moist sugar. I presume that its presence in sugar would be revealed by the odor given off on heating.

## GOLD, PREPARATIONS OF.

THE chief preparations of gold mentioned in the dispensatories are *chloride of gold*, *chloride of gold and sodium*, *iodide of gold*, *cyanide of gold*, *gold powder*, *oxide of gold*, and *chloroacetate of ammonia*. We shall do no more than give the most important tests for gold. The preparation being brought into solution by water, or, if not soluble in this menstruum, by muriatic or nitro-muriatic acid, may be tested for either by a solution of *sulphate of iron*, of *oxalic acid*, or of *chloride of tin*, to which latter a drop of nitric acid is added.

The salt of iron and the oxalic acid precipitate the metallic gold in the form of a brown powder, which on being rubbed with a hard body has the lustre of gold.

The tin salt produces a beautiful purple precipitate, a compound of an oxide of gold with an oxide of tin, called *purple of Cassius*.

Solutions of gold salts are precipitated of a black color by hydrosulphuric acid, the precipitate being soluble in sulphide of ammonium.

### GUAIAC.

#### SYN. *Guaiaci Resina*.

GUAIAC comes in lumps of various sizes, and has a vitreous fracture presenting a surface varying in color from brown to red and green, but it always becomes green after exposure to the light and air. Its powder, at first of a light gray color, becomes, after a while, of a green color. Alcohol and rectified spirit dissolve it readily. "The tincture slowly strikes a lively blue color on the inner surface of a thin paring of a raw potato." (Edin. Pharm.) The most frequent adulterations are the resins, which may be detected by the odor given off on burning coals. "If paper moistened with the tincture be exposed to the fumes of nitric acid, it speedily becomes blue." (Wood and Bache.)

### GUAIACUM-WOOD.

#### SYN. *Lignum Vitæ*; *Guaiaci Lignum*.

THIS wood, as found in the shops, occurs in raspings or shavings. It is probably not subject to adulteration. When genuine, it sinks in water, is a mixture of both yellowish and greenish shavings, and has

an acrid, aromatic taste, attended with a peculiar pricking in the throat. Nitric acid turns it greenish.

## GUM ARABIC.

SYN. *Gummi Acaciæ.*

THIS gum occurs in commerce under several names, according to the appearance it presents, such as *Turkey* or *true gum Arabic*, *Senegal gum*, *East India*, *Cape*, and *South American gum*, &c.

The best or *picked* gum Arabic comes in roundish masses of the size of a walnut, or in fragments, has an opaque white color, and a brittle, crackly appearance. This is principally imported from Smyrna, in fresh wooden cases, lined within with blue bibulous paper.

The other gums are all coarser in appearance, being of a yellowish or reddish color. Some come in angular masses, others, such as the South American gum, in large, reddish, round tears, or in dirty, agglutinated masses. The *true* gums, from whatever sources extracted, have all the same chemical constitution. But the uncolored gums are alone suited for medicinal purposes. The only adulteration practised is that of mixing the best with the inferior qualities of gum, or with cherry gum.

The test for gum is its perfect solubility in water, without swelling, and its being precipitated from its aqueous solution by alcohol. Herberger states that gum Senegal is rather less soluble in water than true gum Arabic, and that the salts of peroxide of iron give, with solutions of equal strength, an *immediate*

ochre precipitate with gum Senegal, but only a red coloration and afterwards a few flakes with gum Arabic. He says also that gum Senegal forms better emulsions with fats and oils.

#### GUM, ARTIFICIAL.

SYN. *Gum Substitute; British Gum.*

THIS gum consists of roasted starch, and is used in calico-printing. It should not be acid, and should form with cold water a good adhesive liquid, much as gum Arabic does. A sort of artificial gum is also made from starch, by means of malt or sulphuric acid, which is called *dextrine*. Its properties are much like the foregoing. It may sometimes contain sugar of starch, which can be discovered by digesting it with common alcohol, filtering, and evaporating, when the sugar will remain behind.

#### GUM TRAGACANTH.

SYN. *Tragacantha.*

THREE principal varieties of tragacanth are met with in commerce, *tragacanth in leaves*, *tragacanth in sorts*, and *vermicular tragacanth*.

That in leaves occurs in broad, thin, nearly white plates, resembling horn in appearance, and marked by spiral or circular ridges; the tragacanth in sorts comes either in lumps, or brown or yellowish leaves, and is less esteemed than the other varieties; while the vermicular tragacanth is generally nearly white,

but comes in minute pieces or filaments; this does not command quite so high a price as that in leaves.

Tragacanth is very tough, and difficult of pulverization, swells up in water, and forms a soft, adhesive paste. It is wholly insoluble in alcohol. The best tragacanth is the whitest. Persoz says that the quality of tragacanth can be best judged of by estimating the quantity of water which a given weight of it will take up, a scruple of it, for instance, which is placed in cold water.

### HEMLOCK.

#### SYN. *Conium Maculatum.*

THE leaves of other umbelliferous plants, which bear a general resemblance to hemlock, are often mistaken and sold for it. The leaves are also often badly cured, or have been kept too long or carelessly. "The powder should be of a fine green color, and should have a very determined odor." (Soubeiran.) The best criterion of the quality of the leaves, extract, and other preparations of hemlock, is the strength of the odor of *conia* disengaged on rubbing them with a solution of potassa. This odor is very characteristic and intense, and is somewhat ammoniacal.

### HONEY.

#### SYN. *Mel.*

HONEY is met with of a consistency varying from that of oil to that of lard.

Fine honey — the best is called *virgin honey* — is thick, viscid, colorless or of a pale straw tint, of a grateful, fragrant odor, with an aromatic, sweet taste. When long kept, it becomes thick from the formation of granular crystals. Inferior sorts of honey are bitterish and brownish. Honey is soluble in water; boiling alcohol also dissolves it, and on cooling deposits crystals of grape-sugar.

Honey is adulterated with *starch*, *flour*, *cane-sugar*, and even occasionally with *chalk*, *plaster of Paris*, and *pipe-clay*. The insoluble constituents may be shown by mixing the honey with a large quantity of water, when they will settle at the bottom of the vessel; if flour or starch is present, a decoction of the honey in water will form a paste which will give a blue reaction with iodine. See *Iodine and Starch Test*. The presence of cane-sugar is more difficult of detection. It is said to render the honey more fluid, and may sometimes be recognized by the taste.

#### HYDROCHLORIC ACID.

SYN. *Muriatic Acid*; *Spirit of Sea-Salt*; *Marine Acid*; *Acidum Hydrochloricum*.

PURE liquid muriatic acid is colorless, of a caustic, acid taste, and a sharp irritating odor; if concentrated it fumes in the air, but if diluted it may be recognized by holding over it a glass rod dipped in ammonia, when a white cloud will be formed.

The muriatic acid of the shops is generally of a yellow color more or less deep, and is mostly contaminated with *inorganic matter*, such as *iron*, and

the various salts occurring in the water which is used in its preparation, with sulphuric, sulphurous, and nitric acids. It is also said to contain sometimes bromine and selenious acid. Arsenic occurs in it, when made from oil of vitriol containing this poison. It is sometimes adulterated with different salts, in order to increase its density.

Inorganic salts are detected by evaporating a portion to dryness; if pure, no residue will be left. If iron is present, it will strike a blue color with prussiate of potash, after the acid has been previously neutralized by ammonia and then some pure acetic acid added in small excess. Sulphuric acid, if present, will cause, after dilution with water, a white precipitate with chloride of barium; having added the latter in excess and filtered, and boiled the clear filtrate with nitric acid, should a white precipitate then form, it indicates the presence of sulphurous acid. Nitric acid is shown by its discoloring indigo solution and dissolving goldleaf. Sulphuretted hydrogen must leave it unaltered. Arsenic can be detected most easily by diluting a concentrated acid with its own bulk of water, which mixture will produce gray spots on a bright piece of copper. To test a dilute acid in this way, it must be previously strengthened by the addition of some pure concentrated acid.

It may be well to state here, however, that the common muriatic acid of the shops is sufficiently pure for most medicinal purposes. For delicate chemical operations, it should be absolutely pure. Nitrate of silver is the test for muriatic acid, forming with it a white, curdy precipitate, soluble in am-

monia. To estimate the strength of muriatic acid, see *Acidimetry*.

### INDIGO.

INDIGO is imported principally from *Calcutta*, *Manilla*, *Caraccas*, and *Guatimala*. That from Calcutta is the most esteemed, and comes in chests covered with gunny-cloth; the Manilla indigo is also brought in chests, but is not covered with gunny-bagging. The Caraccas and Guatimala indigos are packed in seroons.

The Bombay indigo comes in square cakes or fragments of cakes, and possesses a deep blue color, and gives a coppery lustre on rubbing with the nail. The other indigos have a lighter color.

Dealers in indigo, says Persoz, generally judge of the quality of indigo by its specific weight, its sticking to the tongue, its tenacity and uniformity, the facility with which it presents a copper hue on friction with the nail, &c.; but none of these tests are to be relied upon.

After giving the tests for determining the impurities and adulterations of indigo, we shall proceed to give some of the processes by which its actual value may be determined.

The foreign ingredients to be tested for in indigo are *water*, *saline* or *earthy matter*, *starch*, *resin*, *logwood*, and *Prussian blue*.

Water is determined by drying about 30 or 40 grains of pulverized indigo at  $212^{\circ}$  F., until it no longer loses weight; the loss is water, which should not be more than 3 or 6 per cent. My analyses of Calcutta indigo give as a mean  $4\frac{1}{2}$  per cent.

Good indigo, on incineration in a platinum dish, should not yield more than 7 per cent. of *ash*. M. Chevreul has tested an indigo which gave but 3 per cent of ashes.

*Starch*, if present in any quantity, will form a gelatinous mass on boiling a sample of the indigo with a small proportion of water.

*Resin* is estimated by treating a sample of the indigo with alcohol, filtering, and evaporating the filtrate; the residue will show the amount of resin.

If *logwood* is present, it may be detected by moistening the powdered indigo with a little oxalic acid, and applying to this paste a piece of white paper, which will immediately be stained red if logwood is present.

*Prussian blue* is detected by boiling a sample of the powdered indigo with caustic potassa, filtering the liquor, saturating with an acid, and then adding perchloride of iron, which will immediately develop a blue color, which will not be affected by chlorine if this is owing to the presence of Prussian blue.

The above tests are on the authority of Persoz, as given in his standard work, *Traité de l'Impression des Tissus*. Another test for Prussian blue, and which I am not aware as being mentioned, is to treat a portion of the indigo with oxalic acid, which will cause a blue solution if Prussian blue is present, but not otherwise.

Having ascertained the impurities of indigo, the next step is to ascertain the actual amount of indigo-blue it contains. Many processes have been given for this purpose, but most of them are too difficult

of execution, except by the experienced chemist. But a few processes will be given which can be executed by those whose wants this work is intended to supply.

In the first place, I will give, with some modifications, Berzelius's method, which, though it will take six or seven days to perform, gives results that will serve as a standard by which to test all the other methods.

Berzelius first extracted indigo with dilute muriatic acid; the residue left after this treatment was exhausted with a concentrated solution of caustic potassa, and the residue left after this was thoroughly exhausted with alcohol. The residue finally left is indigo-blue, with some inorganic impurities, which can easily be determined by incineration. The indigo-blue is to be dried and weighed, then incinerated, and the ashes deducted from the gross weight of the indigo-blue.

Indigo may also be pretty accurately determined (as I know by many trials) by subliming it at a moderate heat, in a platinum crucible, until there is no longer any escape of purple fumes, weighing the residue, and subtracting it from the original amount of indigo employed. The same samples of indigo give nearly the same results by this method as by that of Berzelius; and let it be remembered that it takes only about as many *minutes* to perform the analysis by the method I propose, as it does *days* by the method of Berzelius.

Another method of easy execution may also be given. Dissolve a small quantity of powdered indigo in Nordhausen sulphuric acid, and then dilute it with

water; the amount of water required to lessen its blue color will be an index of its strength. This process requires an article of known goodness with which to compare it.

The Bengal indigos, which I have analyzed, have generally fallen short of 50 per cent. of pure indigo-blue. They have ranged from 36 to 50 per cent.

I would refer those who wish to make more erudite analyses of indigo than those given here, to the original methods proposed by Dr. Dana of Lowell, and by Fritsche of St. Petersburg, to be found in a work entitled "Practical Treatise on Dyeing and Calico-Printing."

#### IODINE.

SYN. *Iodinum*; *Iodinium*.

At common temperatures, iodine is solid, and occurs in crystalline scales of a bluish-black color and a metallic lustre. It fuses at 225° F., and at 347° boils and distils over in the form of beautiful violet-colored vapors. It emits an irritating odor, and possesses an acrid taste. It is soluble in about 7,000 parts of water, to which it imparts a brownish-yellow color. It dissolves in 12 parts of rectified spirits, at 60°, and is very soluble in ether.

Pure iodine is entirely soluble in alcohol, and is entirely vaporizable on the application of heat. It colors starch blue.

It is sometimes adulterated with *peroxide of manganese*, *charcoal*, &c.; but all the fixed impurities can be easily determined by subliming it in a porcelain dish, when the impurities will remain behind.

Water, of which it often contains a large quantity, is determined by drying it under a bell glass by the side of sulphuric acid or quicklime, or between folds of delicate blotting-paper.

It is also occasionally contaminated with *chlorine*. This is determined by treating a sample with dilute ammonia and adding nitrate of silver, filtering, and then neutralizing the clear filtrate with pure nitric acid; should this occasion a white, curdy precipitate, chlorine is present.

#### IPECACUANHA.

SYN. *Ipecacuan-Root*; *Hippo*.

IPECACUAN-ROOT is in short pieces, of about the thickness of a goose-quill, more or less twisted and bent, traversed by many deep, annular grooves, which impart to it an annulated, jointed, or knotty appearance. It consists of a thick outer cortical portion, of a grayish or grayish-brown color, and a slender, white woody centre. It breaks with a short fracture, and is readily reduced to powder, which is of a brownish-yellow color. It has a faint bitter, somewhat acrid taste, and a weak, peculiar odor.

In the crude state, the ipecacuan of the dispensaries is readily distinguished from other roots by its characteristic appearance, &c. But any adulterations of the powder with other vegetable powders can hardly be recognized except by its medicinal activity. If adulterated with *tartar emetic*, as is said sometimes to be the case, a solution, obtained by digesting a portion of it in water and filtering, will yield an orange precipitate with sulphuretted hydrogen.

## IRON, AMMONIO-TARTRATE OF.

SYN. *Ferri Ammonio-tartras.*

THIS salt occurs either in scales or angular grains, of a beautiful deep-garnet color, brilliant and semi-transparent. It has a sweetish, slightly chalybeate taste, and is very soluble in water, but insoluble in absolute alcohol and in ether.

## IRON, CITRATE OF.

SYN. *Ferri Citras.*

AND

## IRON, AMMONIO-CITRATE OF.

SYN. *Ferri Ammonio-citras.*

BOTH of these preparations are semi-transparent, and of a shining garnet-red color, and have a mild chalybeate taste. *Citrate of iron* is permanent in the air, slowly soluble in cold water, but readily in boiling water, and the solution reddens litmus-paper. The *ammonio-citrate* is readily soluble in both cold and hot water, and deliquesces in the air. Its solution is neutral to test-paper.

## IRON, FERROCYANIDE OF.

SYN. *Ferrocyanate of Iron; Prussiate of Iron; Prussian Blue; Berlin Blue; Paris Blue; Ferri Ferrocyanas; Ferri Cyanuretum.*

FERROCYANIDE OF IRON is of a rich dark-blue color, adheres to the tongue, and is insoluble in water,

alcohol, and in diluted acids. It is prepared either *with* or *without* alumina; the former variety is sometimes designated more particularly as *Paris blue*, and the latter as *mineral blue*, while the term *Prussian blue* is a general term, embracing all varieties, whether pure or prepared with *alumina, clay, starch, &c.*

*Alumina* changes the tint, and diminishes its richness; it is detected by boiling with dilute acetic acid, and testing the filtrate with ammonia, which precipitates it, if present.

*Prussian blue*, according to Persoz, is often adulterated with a large proportion of starch, which is completely disguised by being colored with iodine. When present in large quantities it may be detected, says the same authority, by melting and intumescing on burning coals, whilst pure Prussian blue, or that which is mixed with only a small quantity of starch, is decomposed without melting.

Prussian blue is also sometimes injured in its color by the presence of free *sesquioxide of iron*, which imparts to it a dingy greenish tinge; this may be detected by boiling in dilute acetic acid, when the filtrate will give a brownish precipitate with ammonia.

If *chalk* is present, it effervesces with an acid.

The *coloring power* of Prussian blue may be tested by grinding a portion of it with twenty-five or thirty times its weight of white-lead and oil, and comparing the color with that produced by an equal weight of what is known to be genuine Prussian blue.

*Turnbull's blue* is a *ferricyanide of iron*. The tint of this blue is lighter and more delicate than that of

Prussian blue. "Mr. R. C. Campbell observed that the ferricyanide of iron may be distinguished from Prussian blue by the circumstance, that, when boiled in a solution of yellow prussiate of potash, it affords red prussiate of potash, which dissolves, and a gray, insoluble residue of ferrocyanide of iron and potassium."

### IRON, IODIDE OF.

SYN. *Ferri Iodidum.*

AND

### IRON, SYRUP OF IODIDE OF.

SYN. *Solution of Iodide of Iron; Syrupus vel Liquor Ferri Iodidi.*

IODIDE OF IRON occurs in small crystalline masses, is of a greenish color, has a styptic, metallic taste, is very deliquescent, and dissolves readily in water and in alcohol. It should entirely dissolve in water, and the solution should be of a pale-green color.

The syrup of iodide of iron should also be of a pale-green color, and should contain no sediment. When it is *colored brown*, it shows that it has undergone decomposition. It should not strike a blue color with starch.

Iodide of iron exposed to the air absorbs oxygen, rapidly forming sesquioxide of iron and free iodine. Such an article may produce serious accidents when administered, if the decomposition has progressed far, and there is much free iodine present. It would be by far the best, if apothecaries should always prepare it extemporaneously when prescribed. Any

mixture containing it should not be dispensed without having an iron wire suspended in it, to combine at once with any iodine which may be set free by the action of the atmosphere.

#### IRON, LACTATE OF.

SYN. *Lactate of Protoxide of Iron; Ferri Lactas.*

THIS salt occurs in white or nearly white crystalline plates. It is but slightly soluble in water. It has a feeble chalybeate, not disagreeable taste. It is said sometimes to be adulterated with *effloresced green vitriol, starch, &c.* The first is readily detected by the *baryta test* for sulphuric acid, and starch by the *iodine test*. However, these adulterations can be practised on the powder only, and therefore this salt should always be purchased in the form of the crystalline plates.

#### IRON, PILLS OF CARBONATE OF.

SYN. *Vallet's Ferruginous Pills; Pilulæ Ferri Carbonatis.*

VALLET'S pills are composed of protocarbonate of iron, and are in a great measure protected against oxidation by being made with a strong syrup. The soft mass *effervesces* with an acid, thus showing the presence of a carbonate.

## IRON, POTASSIO-TARTRATE OF.

SYN. *Tartrate of Iron and Potassa; Tartarized Iron; Ferri et Potassæ Tartras.*

THIS salt occurs in olive-colored grains, or in transparent scales of a brownish-red color. It now usually occurs in the latter form. It is uncrystallizable, and it has a feeble styptic, metallic taste. It is soluble in water and in alcohol. Its solution should not be precipitated by a cold solution of potassa or by prussiate of potassa, and it should be neutral to test-paper.

## IRON, POWDER OF.

SYN. *Iron reduced by Hydrogen. Ferri Pulvis.*

THIS powder is of an iron-gray color. It should easily dissolve in dilute muriatic or sulphuric acid with disengagement of hydrogen. If it contains the *black oxide of iron*, this will not so readily dissolve.

It is not impossible that some persons may prepare it with hydrogen generated from impure zinc, and that, in consequence of this, it may contain *arsenic*. This would be shown by *Marsh's Test*.

## IRON, RED OXIDE OF.

SYN. *Peroxide or Sesquioxide of Iron; Colcothar.*

THIS is a reddish-brown powder, tasteless, inodorous, insoluble in water, but soluble in muriatic acid, without effervescence.

If it contain *brick-dust* or *other earthy impurities*,

these will not dissolve in highly concentrated muriatic acid. The muriatic acid solution will deposit *metallic copper* on a bright knife-blade, if it contains this metal. This oxide is soluble with difficulty in strong muriatic acid.

The *subcarbonate of iron* of the pharmacopœias is a hydrated sesquioxide of iron containing a little carbonate of iron. It should be easily soluble in dilute acids.

*Hydrated sesquioxide of iron*, which is employed as an antidote against poisoning by arsenic, must be prepared according to the directions given in the pharmacopœias.

#### IRON, SULPHATE OF.

SYN. *Sulphate of Protoxide of Iron; Green Vitriol; Copperas; Ferri Sulphas.*

SULPHATE OF IRON occurs in crystals of a bluish-green color; it is very soluble in water, and insoluble in alcohol.

It is often contaminated with *sesquioxide of iron*, which is known by the yellowish-brown color of the crystals, and with *copper*, which, if present, will be deposited as a coppery-colored film on a bright slip of iron immersed in its solution. The presence of *zinc* is discovered, by adding an excess of ammonia to a solution of the salt, acidified with nitric acid and boiled, filtering the solution, and then expelling the excess of ammonia from the filtrate by boiling, when oxide of zinc will separate in white flakes. Upon adding hydrosulphuric acid to the ammonia-

cal solution, the zinc will be precipitated as a white sulphuret at once.

As commercial copperas often contains *alumina*, it may be tested for in the following way. Add potassa lye in excess to the solution, boil and filter; to the filtrate add sulphuretted hydrogen, which will throw down the zinc, if any is present, and again filter. Then neutralize the filtrate with muriatic acid, and afterwards add ammonia in excess, when the alumina will fall as a gelatinous precipitate.

For some medicinal purposes, the sulphate of iron is dried to expel most of its water of crystallization, *Ferri sulphas exsiccatum*; and for many delicate chemical operations, it is precipitated from its solution by alcohol, washed with alcohol and dried between blotting-paper, and then preserved in closely-stoppered vials. This latter preparation resists more strongly the oxidizing influence of the air than the common crystallized salt. (See page 67.)

#### IRON, SULPHURET OF.

##### SYN. *Sulphide of Iron.*

As prepared in the laboratories for chemical purposes, sulphide of iron occurs in various-sized fragments of a dark-gray metallic appearance. It is the article from which the chemist generates *sulphuretted hydrogen* (hydrosulphuric acid), of such very extensive application in chemical analysis.

To generate this gas, introduce a few pieces into a pint glass flask, fitted with a perforated cork and a properly bent tube, and pour over the sulphide some

diluted sulphuric acid, when the gas will immediately be given off with effervescence, and may be conducted into a bottle of pure water by means of the tube, thus forming a *solution of hydrosulphuric acid* of constant use in the laboratory; or it may be conducted directly into the liquor containing the substance to be acted upon by it. The *solution of hydrosulphuric acid* should be kept in well-closed bottles, and even then should be prepared fresh every week. If the gas is passed into water of ammonia, until this no longer gives a precipitate with a solution of Epsom salts, that important chemical reagent, *sulphide of ammonium*, is formed. Sulphuretted hydrogen should not be generated where it can be inhaled, as it is very poisonous.

## ISINGLASS.

SYN. *Fish-glue, Ichthyocolla.*

ISINGLASS is a gelatinous substance, consisting of the dried swimming bladders or sounds of certain fish, principally of the sturgeon tribe. The Russian isinglass is regarded as the best. It comes either in the form of leaves, or in pieces twisted up in the shape of a lyre or horse-shoe. The best is whitish, semi-transparent, inodorous, and tasteless, readily and completely soluble in boiling water, and on cooling forms a semi-transparent and solid jelly. Soubeiran states that one part of isinglass will give to 30 parts of water a good consistency. Normandy states that spurious isinglass, made from the intestinal membranes of the calf and sheep, although inodorous,

has a saltish flavor, and is in thinner pieces than the genuine isinglass, and if treated with boiling water, about one third of its weight is left in an insoluble state, and the liquor does not form a good jelly.

It is likewise prepared of inferior quality from other fish besides sturgeon, and is said to be adulterated also with fine shreds of fish-skin, &c. But its purity may be known by its want of smell, its entire solubility in water, and its solution being transparent.

#### JALAP.

#### SYN. *Jalapa.*

JALAP root occurs in commerce either in the entire tuber, generally incised more or less deeply, or in pieces of various forms and sizes. The tubers are ovoid, and vary in size from that of a nut to that of an orange, externally brown and wrinkled, internally grayish, and marked with darker concentric zones. They are compact and brittle, and the fracture is somewhat mottled and shining, and presents many brilliant resinous points. The odor and taste are both nauseating, and the inhalation of the powder causes sneezing. The powder is of a yellowish-gray color. Some pieces are worm-eaten, but these are the most active, as the resin—the active principle—is left untouched in them. Jalap should yield with rectified spirits from 10 to 13 per cent. of resin.

True jalap can be distinguished for the most part by the above description. When spongy and wanting in compactness, and without a bright fracture, it should be condemned.

## KELP.

SYN. *British Barilla; Vareck.*

KELP is obtained by burning various kinds of seaweed, principally the Algae and Fuci, and occurs in dark bluish-gray masses. It contains between 5 and 8.5 per cent. of carbonate of soda, a great variety of other salts, and among them a little iodide of sodium.

## KINO.

As occurring in the shops, kino is in small, angular, shining, brittle, friable fragments, of a dark-brownish or reddish-black color, opaque in mass, translucent and garnet-red in splinters. It imparts to the saliva and to boiling water a blood-red color. It is odorless, but has an intensely astringent taste.

Other astringent substances are sometimes substituted for kino, but none of them have the same characteristic color, brilliancy, and friability which pertain to it.

## LAC.

SYN. *Gum Lac.*

THERE are four principal varieties of lac, namely, *stick lac*, *seed lac*, *lump lac*, and *shellac*.

Stick lac is lac in its natural state, incrusting leaves and twigs, and undeprived of its red coloring matter. (See *Lac Dye*.) M' Culloch says, "The best stick lac is of a deep-red color. When held against the light, it should look bright, and when broken,

should appear in diamond-like points. If it be not gathered before the insects have left their cells, it becomes pale, and pierced at the top, and is of little use as a dye, though probably better for a varnish."

Seed lac is the lac broken off from the twigs, and partially deprived of its coloring matter by water. It occurs in small yellowish-brown grains. When melted and formed into cakes, it constitutes lump lac.

Shellac is prepared from seed lac by melting, and straining through a cloth, and letting it drop on to leaves and smooth stems of trees, so as to form thin sheets or plates. Thin, transparent *orange shellac* is the best; the next best is *ruby shellac*, and the least esteemed is *liver shellac*, so called from its brownish color. When ruby shellac is in roundish pieces, it is known as *button shellac*. Shellac, when laid on a hot iron, will, if pure, instantly catch fire, and burn with a strong, but not unpleasant odor.

Normandy states that, "when shellac breaks with a dull fracture and with ragged edges, it has been overdosed with rosin. Good shellac, on breaking, should snap with a clear sound, and should have a smooth, horny appearance, like strong glue." The same author states that all the lacs (except the impurities, such as the fragments of branches, and insects) "should completely dissolve in alcohol, naphtha, and in dilute alkaline water. These criteria are of great importance; for stick lac, and more especially seed lac, are often adulterated to an incredible extent. I examined once a large number of samples of seed lac for a London merchant, and I found them mixed with from 56 to 95 per cent. of insoluble gum! The

fraud had been practised by the natives in India, and the importer accordingly suffered a most serious loss."

#### LAC DYE.—LAC LAKE.

LAC DYE and lac lake are prepared, by different processes, from stick lac. Like cochineal, they contain *carmine*, to which they owe their tinctorial qualities. They are advantageously substituted for cochineal in the preparation of scarlet. Lac dye is imported from Calcutta, in cakes of about two inches square by half an inch in thickness, and having certain marks, such as CAV, DT, &c., &c., impressed upon them. Certain marks have a high reputation, but as these marks are imitated, it is best not to rely upon them in judging of the value of lac dye. Lac dye has a chocolate color, and the best article presents a shining, smooth, and compact fracture; however, that which mostly appears in our market presents a dull and earthy fracture. "The finest qualities of lac dye," says M'Culloch, "are seldom met with for sale in Calcutta, being generally manufactured under contract for the European market."

Normandy gives the following method of determining the tinctorial value of lac dye and lac lake, "which is done by comparison, dying a certain portion of wood, cloth, or flannel as described below and comparing the color with that produced in the same conditions by genuine and best lac dye.

"The dye-bath is prepared as follows:—

5 grains of cream of tartar (argol).

20    "    "    flannel, or white cloth.

5 grains of lac dye.

5 " " chloride of tin.

1 quart of water.

" The following proportions may also be used : —

5 grains of cream of tartar (argol).

60 " " white cloth or flannel.

5 " " lac dye.

1 pint of water.

" Heat the water to the boiling point in a tin or china vessel : add thereto the cream of tartar (argol), and then the piece of cloth or flannel, previously weighed. Weigh off five grains of the lac dye, and pulverize it in a Wedgwood mortar, with five grains (by measure) of chloride of tin, and pour the whole into the hot liquor containing the argol and the cloth, taking care to rinse the mortar with a little of the hot liquor ; keep the whole boiling for at least one quarter of an hour, or even half an hour, stirring the cloth and flannel about by means of a glass or wooden stirrer. At the end of that time, the cloth should be withdrawn, washed in cold water, and then dried."

#### LEAD, ACETATE OF.

SYN. *Superacetate of Lead; Sugar of Lead; Salt of Saturn; Plumbi Acetas.*

THIS salt occurs in commerce under two different forms, *white* and *brown* sugar of lead. The latter is made from pyroligneous acid, and has a smoky odor, and comes in deep-brown colored masses.

The white sugar of lead occurs in white lumps,

made up of fine acicular crystals. It possesses an acetous odor, and a sweet, styptic taste.

It is seldom adulterated, but sometimes contains *acetate of lime* and *copper*; the latter may be readily detected by the fine blue tinge communicated by ammonia to a solution of it, and the former by precipitating the copper by hydrosulphuric acid, and testing the filtrate with oxalate of ammonia, which will give a white precipitate if lime is present.

*Tests.*—Calcination with charcoal will give beads of metallic lead. In a solution of it, hydrosulphuric acid will give a black precipitate, sulphuric acid a white precipitate, and bichromate of potassa a canary-yellow precipitate. If dilute sulphuric acid be added to the solution as long as any precipitate of sulphate of lead falls down, the filtered liquor, on evaporation and heating, should leave no considerable residue.

#### LEAD, CARBONATE OF.

SYN. *White-Lead*; *Ceruse*; *Krems or Kremnitz White*; *Hamburg White*; *Dutch White*; *Flake White*, &c.; *Plumbi Carbonas*.

THE pigment known as white-lead is a basic carbonate of lead, that is, a compound of carbonate of lead with hydrated oxide of lead in two different proportions.

White-lead occurs in commerce as a heavy, opaque, pure white mass, inodorous and tasteless, insoluble in water, but soluble with effervescence in dilute nitric acid and in acetic acid. Hydrosulphuric acid

blackens it. Heat alone renders it yellow, but with charcoal reduces it to the metallic state. Potassa causes in the nitric acid solution a white precipitate, soluble in an excess of the precipitant.

The adulterations to be sought for in white-lead are *sulphate of lead*, *sulphate of baryta*, and *chalk*; but the two latter are the most common adulterations, and to test this mixture of barytes and chalk, treat the sample of white-lead with dilute nitric acid, which dissolves the carbonate of lead and the chalk, but leaves the barytes undissolved, and this may be collected on a filter, dried, ignited, and weighed. The clear solution of the nitrates is then evaporated to dryness, and the residue treated with alcohol, which dissolves the nitrate of lime, but does not take up the nitrate of lead.

Should sulphate of lead be the fraud, the above process will also apply, as sulphate of lead is, like barytes, insoluble in nitric acid; but when sulphate of lead and sulphate of baryta are both present, after treating with pure nitric acid, wash the residue thoroughly with pure water, until the latter shows no lead reaction with sulphuretted hydrogen. Add to a small quantity of the insoluble residue a solution of sulphuretted hydrogen; if it does not turn black, it contains no lead. If it does turn black, boil another quantity of the residue repeatedly with a solution of potassa; if the whole was sulphate of lead, it will be dissolved; if barytes was present, it will remain behind.

When white-lead, *mixed with oil*, is to be examined for these adulterations, the oil must first be got

rid of, by digesting the substance with spirits of turpentine, and afterwards washing with alcohol, and then proceeding exactly as above.

#### LEAD, CHROMATE OF.

SYN. *Chrome-Yellow*; *Yellow Chromate of Lead*.

THIS is a fine yellow pigment, and several shades are met with in commerce, *pale yellow*, *yellow*, *full yellow*, and *orange* (the latter is a subchromate). The pure substance is wholly and easily soluble in a boiling solution of potassa.

It is said to be often adulterated with *sulphate of baryta*, *sulphate of lime*, *carbonate of lead*, *carbonate of lime*, and *starch*. The carbonates may be detected by the effervescence caused on the addition of an acid; starch, by treating a cooled decoction with a solution of iodine (see *Starch and Iodine Test*); sulphate of lime, by digesting a portion in water and testing for sulphuric acid with chloride of barium (see *Baryta Test*), and for lime with oxalate of ammonia (see *Lime Test*). But it should be stated, that many of the above substances are not added from any fraudulent design, but merely to produce different shades of yellow.

#### LEAD, NITRATE OF.

SYN. *Plumbi Nitrás*.

NITRATE OF LEAD occurs in octahedral crystals, which are nearly white, generally opaque and lus-

trous, and anhydrous. Water dissolves about one seventh of its weight of this salt. The crystals decrepitate on burning charcoal, and leave metallic lead behind. Like all the nitrates, nitrate of lead makes combustion more lively, and for this reason is added to some of the best friction-matches.

The general impurities are *nitrate of copper*, and excess of *nitric acid*; the former is detected by the copper test, and when the salt is perfectly dry it cannot contain any free nitric acid. These impurities render this salt unfit for the manufacture of matches, and the presence of the copper salt would in most cases make it unfit for dyeing.

#### LEAD, PROTOXIDE OF.

SYN. *Semivitrified Oxide of Lead*; *Litharge*; *Massicot*; *Plumbi Oxidum Semivitreum*.

WHEN protoxide of lead has not undergone fusion, it is called *massicot*, but after fusion it is called *litharge*. Massicot is of a yellow color; litharge varies in its color from yellow to a reddish yellow. It is heavy, has a foliaceous structure when in mass, and a scaly appearance as usually sold. It has no taste nor smell, and is insoluble in water or spirit. It slowly attracts carbonic acid from the air. As occurring in commerce, it usually contains some *iron*, *copper*, and a little *silver* and *silica*. It may be adulterated with *brick-dust* or *sand*. The English litharge is most esteemed, that from Germany being liable to contamination with iron and copper. Two varieties of litharge occur in commerce; when of a pale-yel-

low color and silvery appearance, it is called *litharge of silver*, or *yellow litharge*; and when of a red color, it is denominated *litharge of gold*, or *red litharge*. It is important to the apothecary to have pure litharge, as a contaminated article would injure his *lead-plaster* and *lead-water*.

It should dissolve entirely in dilute acetic acid, without effervesce. This test will indicate all such impurities as sulphate of baryta, sand, brick-dust, &c. On precipitating this solution with sulphuric acid, iron, copper, and other impurities remain in solution. They may be detected in the filtered solution, after evaporating it to dryness and redissolving in a little water, by the usual tests. See *Appendix*.

Christison says that good litharge never contains quite so much as one per cent. of impurities.

#### LEAD, RED OXIDE OF.

SYN. *Red-Lead*; *Minium*; *Plumbi Oxidum Rubrum*.

RED-LEAD is a heavy powder, of a bright scarlet color, and is composed of two parts of protoxide and one part of peroxide of lead. But the minium of commerce is far from having this constitution; M. Dumas says that he has found in it one half its weight of massicot. "The color of the minium is finer in proportion as it has the above constitution." (Soubiran.)

The presence of foreign matters in red-lead may be tested for in the same way as in litharge, but it must be previously ignited in order to render it completely soluble in nitric acid.

## LIME.

SYN. *Quicklime*; *Caustic Lime*; *Calx*.

*Slaked Lime*; *Calcis Hydras*.

QUICKLIME is a grayish-white, brittle, earthy-like substance. It is soluble in about 700 parts of cold water, and in about 1,200 parts at 212° F.

Lime of good quality, when properly moistened with water, splits in all directions, and crumbles down into a fine white powder, with the development of heat. This is *hydrated* or *slaked* lime. This should dissolve in nitric acid without effervescence and without leaving any residue, showing that it contains neither *carbonic acid* nor *silicic acid* in its *insoluble modification*. After evaporating the nitric acid solution to dryness, and treating the residue with water, if any part remains insoluble, then *silicic acid* in its *soluble modification* is present. The aqueous solution treated with an excess of lime-water should not become turbid, as this would show the presence of *magnesia*. If the acid solution should be precipitated by ammonia, the presence of *alumina* and *iron* would be indicated. *Soda* or *potassa* is indicated by adding an excess of oxalate of ammonia to the acid solution, filtering, evaporating the filtrate to dryness, and calcining it to expel all excess of oxalate of ammonia; should any residue remain which is soluble in water, potassa or soda is present.

*Lime-water* must redden turmeric paper strongly, and yield no inconsiderable precipitate with carbonate of potassa.

For the purpose of making mortar for buildings, the absolute purity of the lime is of course not of importance. But pure lime will always be more valuable than an impure article, which would not bear so large an admixture of sand. Bricklayers judge of the value of lime by the tenacity of the mortar which it forms with sand. In many parts of the United States it is difficult to procure a pure lime, especially one which is free from magnesia. Burnt oyster-shells form a very good lime, and are often made use of as such.

As to the *hydraulic lime*, or so-called *cement*, or *Roman cement*, its quality does not seem to depend very intimately upon its chemical composition, and its value can probably best be judged of by a practical test of its properties as a cement.

#### LIME, CARBONATE OF.

SYN. *Prepared Chalk*; *Creta Præparata*.  
*Precipitated Carbonate of Lime*; *Calcis Carbonas Præcipitatus*.

PREPARED CHALK is liable to contain some silica and earthy impurities: these are detected by being mostly insoluble in diluted muriatic acid, while the chalk is wholly soluble in it.

Some time ago an acquaintance of mine showed me an article which he had been prescribing for carbonate of lime, and which proved to be *gypsum*; and I afterwards learned from a druggist in Boston that he had offered to him what was represented as a superior article of prepared chalk, but which he

declined purchasing, as he knew it could not be pure from its great weight. But he said he knew of one apothecary who had bought some of the same lot, and, after dispensing it a few times, discovered that it was not chalk, but gypsum. Gypsum is easily recognized, by its not effervescing with an acid; and by treating it with boiling water, when the filtered liquor will give a white precipitate both with muriate of barya insoluble in acids, and with oxalate of ammonia.

#### LIME, CHLORIDE OF.

SYN. *Chlorinated Lime ; Hypochlorite of Lime ; Bleaching-Powder ; Calx Chlorinata.*

CHLORIDE OF LIME is a dry, white, or dull-white powder, having a chlorine odor, and an acrid, alkaline taste. It deliquesces in the air. It is partially soluble in water. It is often of inferior quality, from being insufficiently charged with chlorine. This compound, by long keeping, especially in warm places, gradually becomes inert, and changes into a mixture of chloride and chlorate of lime. When, in the process of manufacturing, the absorption of the chlorine goes on too rapidly, so that considerable heat is produced, this change also takes place.

For medicinal purposes, the Edinburgh tests are sufficient, which see in any of the dispensatories; but for the arts, a chlorimetical test must be used, which see under the head of *Chlorimetry*.

## LIME, PRECIPITATED PHOSPHATE OF.

SYN. *Calcis Phosphas Præcipitatum.*

THIS is made by dissolving bone-ashes in muriatic acid, precipitating with ammonia and washing the precipitate until nitrate of silver no longer throws down any thing from the wash-waters, and drying. It then constitutes a very fine powder, perfectly insoluble in water, but soluble in either dilute muriatic or nitric acid. *Ground bone-ashes* are sometimes sold for this article ; the powder, however, is never as fine as that of the precipitated article. Precipitated bone-ashes may contain *carbonate of lime* and *carbonate of magnesia*. On pouring a small quantity of muriatic acid upon the powder, it will be neutralized by these salts ; and this is a very good test for the sophistica-tion, not a particle of pure precipitated phosphate of lime being dissolved by a few drops of dilute mu-riatic acid, without the solution being acid.

## LIME, SULPHATE OF.

SYN. *Gypsum* ; *Plaster of Paris.*

PLASTER OF PARIS is native gypsum burnt and ground. It is a white powder, and, when made into a paste with water, it sets in a minute or two, form-ing a hard mass, which property causes it to be ex-tensively employed in casts, statuaries, stucco-work, &c. When plaster of Paris is heated above 300° F., it does not solidify on moistening it with water. Ure states that “ works excuted with pure gypsum never

become so hard as those made with the calcareous kind," which is known by its effervescing with an acid. According to Regnault, the plaster-stone about the environs of Paris contains

Sulphate of lime,	. . . . .	70.39
Water,	. . . . .	18.77
Carbonate of lime,	. . . . .	7.63
Clay,	. . . . .	3.21
		<hr/> 100.00

## LIQUORICE.

SYN. *Liquorice Juice or Paste; Black Sugar; Extractum Glycyrrhizæ.*

CRUDE LIQUORICE is generally imported in rolls from five to six inches long, and about an inch in diameter; sometimes it comes in rolls of a much less diameter, and also in mass, packed in boxes. Liquorice rolls are usually more or less flexible, and interiorly they are of a dark-brown color, without lustre; but the best crude liquorice is brittle, hard, has a bright fracture, is black, has a sweet and slightly bitterish taste, and is almost wholly soluble in water. Crude liquorice is very subject to adulteration with *starch, lampblack, sand, juice of prunes, cherry gum, gum Arabic, copper, &c.* The taste, appearance, and solubility in water are the best means by which to judge of its quality.

*Refined liquorice*, which is made up into little shining sticks, is liquorice which has undergone a process of purification and manufacture.

## LITMUS.

SYN. *Turnsole.*

THE best litmus is prepared in Holland, and comes in small rectangular pieces of a blue or violet color. It has very much the odor of indigo.

Litmus is used to prepare *blue and red test-papers*. The former is prepared by staining thin, unglazed writing-paper with infusion of litmus, and drying; and the red litmus-paper, by passing the blue paper through water acidulated with a few drops of acetic acid. *Blue litmus-paper* is turned *red* by acids; and *red litmus-paper* is restored to its original *blue* color by alkalies; hence their great application in chemistry for testing for free acids and alkalies. The quality of litmus may easily be inferred by the intensity with which it colors dilute alcohol.

## MADDER.

SYN. *Dyers' Madder*; *Rubia Tinctorum.*

MADDER is sometimes imported in the coarse root, but usually in powder. The best *roots* are of the size of a common goose-quill, have a reddish appearance and a strong odor. The *ground madder* varies in color from yellowish to red, and gives off a heavy odor, somewhat resembling that of opium.

Until the present time, all attempts to estimate the value of madder by pure chemical means have proved unavailable, the dyer alone being able to judge of it by its tinctorial powers. For the pro-

cesses employed by him, we must refer to works which treat of dyeing and calico-printing.

Madder is often inferior on account of the large amount of moisture it contains, and is also often adulterated with such inorganic substances as *ochre*, *brick-dust*, &c. These are two very important factors to be determined. The ashes should not amount to more than ten per cent. Earthy matter may also be found by stirring the powder with water, when the earth will subside to the bottom of the vessel.

#### MAGNESIA.

SYN. *Calcined Magnesia*; *Oxide of Magnesium*;  
*Talc Earth*; *Bitter Earth*; *Magnesia Usta*.

MAGNESIA is a very light, soft powder, of snowy whiteness, odorless, earthy to the taste, and is almost entirely insoluble in water. *Henry's calcined magnesia* is denser and more ponderous. In England, this latter magnesia obtains the preference, while in France the *lighter magnesia* is preferred.

Calcined magnesia is liable to adulteration with *carbonate of magnesia*, *lime*, *alumina*, and *silica*.

Carbonate of magnesia is indicated by effervescing with acetic acid; if it contain silica, it will not dissolve completely in diluted muriatic acid, and the muriatic acid solution will give a white precipitate with ammonia, if alumina is present; and if carbonate or oxalate of ammonia gives a precipitate in the clear muriatic acid solution neutralized with ammonia, then the presence of lime is shown. Henry's

calcined magnesia is not so readily attacked by acids as common magnesia. The acid solution should yield no precipitate with chloride of barium, as this would indicate the presence of a *sulphate*. "Magnesia, when calcined in iron vessels, is liable to be contaminated with oxide of iron." (Soubiran.) Such a magnesia would not be perfectly white.

#### MAGNESIA, CARBONATE OF.

SYN. *Subcarbonate of Magnesia; Magnesia Alba.*

MAGNESIA ALBA is a light, bulky, and very white substance. It is inodorous and tasteless, and nearly insoluble in water. Two sorts are met with, one very light and in cubical cakes (*light magnesia*) ; the other dense and somewhat granular (*heavy or ponderous magnesia*).

Like calcined magnesia, it is liable to adulteration with *lime*, *alumina*, *silica*, and *sulphates*, and these may be detected by the same method. It is also sometimes contaminated with carbonate of soda or potassa, and chloride of sodium. If repeatedly washed with distilled water, these salts will be detected on evaporating the wash-waters to dryness.

#### MAGNESIA, SULPHATE OF.

SYN. *Epsom Salts; Bitter Purging Salt; English Salt; Seidlitz Salt; Magnesia Sulphas.*

THIS salt usually occurs in small, colorless, acicular crystals, is inodorous, and bitter ; when pure, it efflo-

resces on exposure to the air; that of commerce does not always effloresce, since it often contains *chloride of magnesium*, which is deliquescent. It dissolves in its own weight of water at 60°, and is insoluble in alcohol.

Epsom salts are not liable to adulteration, but they are often contaminated with *chloride of magnesium*, and with *iron*. Before Epsom salts were so cheap as at present, they were liable to adulteration with *Glauber salts*, and this fraud is still said to be practised on the continent of Europe.

*Chloride of magnesium* is detected by the *Silver Test*, and iron by the *Prussiate Test*. (See Appendix.)

To determine Glauber salts in Epsom salts, mix the solution of sulphate of magnesia with sulphuret of barium, which throws down all the magnesia, while sulphate of baryta is deposited at the same time; add to the filtered liquor sulphuric acid in slight excess, to decompose the remaining sulphuret of barium, and to precipitate all the baryta as sulphate of baryta; if the Epsom salts were pure, sulphuric acid alone remains in solution, and is entirely dissipated by evaporation, but if any sulphate of soda has been added to the salt, it will be left as a residue after evaporation of the liquor.

The Edinburgh test for determining its purity is the following: "Ten grains dissolved in a fluid ounce of water, and treated with a solution of carbonate of ammonia, are not entirely precipitated by 280 minims of a solution of one part of phosphate of soda in 20 parts of water."

Oxalic acid, which, from closely resembling Epsom salts in appearance, has been so often fatally administered in their stead, may be readily distinguished by effervesing with a solution of carbonate of soda, without disturbing its transparency, whereas Epsom salt does not effervesce with it, but renders the clear solution opaque and milky. (See *Oxalic Acid.*)

#### MANGANESE.

SYN. *Peroxide of Manganese*; *Binoxide of Manganese*; *Hyperoxide of Manganese*; *Black Oxide of Manganese*; *Pyrolusite*; *Brownstone*; *Glassblowers' Soap*.

*Hydrated Peroxide of Manganese*; *Bog Manganese*; *Wad*; *Black Wad*.

BLACK oxide of manganese occurs in commerce both in lumps and in powder. The more crystalline its aspect, the better it is. It should be dark and shining. When of a brown color, its quality is not good.

*Wad* differs from black oxide of manganese in containing 20 to 25 per cent. of *water*, and it has a dull, earthy aspect.

Manganese almost always contains *earthy carbonates*, *sesquioxide of iron*, *alumina*, *silica*, more or less *water*, and sometimes *organic substances*.

Many methods are given for estimating the value of manganese, either from the amount of chlorine which it will yield with muriatic acid, from the quantity of free oxygen which it can be made to give off, or from the amount of carbonic acid it will yield

with oxalic acid. But I shall offer but one of these methods, as that of very general acceptance, and of comparatively easy performance. It is almost verbally taken from Graham's Chemistry.

The percentage value of manganese may readily be found by digesting 50 grains of the sample in an ounce and a half of concentrated hydrochloric acid, diluted with half an ounce of water, and adding portions of protosulphate of iron (for the preparation of which, see article *Chlorimetry*) from a weighed sample of not less than 317 grains, at first freely, and afterwards in smaller doses, till the liquor gives a blue precipitate with *red* prussiate of potassa, and ceases to evolve the odor of chlorine. Heat should be employed towards the end of the operation. The quantity of protosulphate of iron consumed must now be ascertained by weighing the amount of salt not consumed. Pure binoxide would have just required the employment of all the proto-salt, to have converted it by means of the extricated chlorine into a per-salt; if the whole is not consumed, the percentage of pure binoxide of manganese may be calculated by the rule of three, as, supposing 298 grains of the sulphate were consumed, then as 317 : 100 :: 298 : 94 per cent. of binoxide of manganese. The percentage value of the oxide for evolving chlorine may be obtained by multiplying the weight of the peroxidized sulphate of iron by 0.2588, which in the above case would give 77 per cent. of chlorine.

My analyses of manganese in our market give percentages ranging from 54 to 86 per cent. of peroxide of manganese.

I would here particularly refer to Fresenius's Quantitative Analyses those who desire to test this ore by the very exact method of Wills and Fresenius.

#### MANGANESE, SALTS OF.

THESE salts have a delicate rose-tint. When they are precipitated from their solutions of a fine *flesh-color*, by sulphide of ammonium, and the filtrate gives no residue when evaporated to dryness and heated, they may confidently be pronounced pure. When the precipitate by sulphide of ammonium is dingy-colored or blackish, it contains some impurity, such as iron.

#### MANNA.

THERE are many varieties of manna, which are generally distinguished as *flake manna*, *manna in sorts*, and *fat manna*.

Flake manna is in stalactiform pieces, uneven, porous, and friable, of a yellowish-white color, and somewhat soiled on that side by which they adhered to the tree. It has a faint, peculiar odor, and a characteristic sweet taste. Fat manna is in fragments, of a brownish or yellowish color, of a strong, nauseous odor, and of a mawkish, sweet, and disagreeable taste, and is generally mixed with *fragments of bark*, *sand*, &c. Manna in sorts comprises that manna which is intermediate in its qualities between the other two. Manna is soluble in three parts of water at 60°, and in eight parts of rectified spirit.

"It is imitated by a preparation composed of

honey and sugar, with a little scammony or gamboge to render it purgative. It is too bungling a fraud to impose upon those who know the proper yellowish-white color, and soft, granular texture of manna." (Rennie.) The taste and close inspection will be a sufficient guide in judging of the better qualities. Inferior qualities should not be tolerated for medicinal use.

## MASTICH.

SYN. *Mastic*; *Mastiche*.

MASTICH occurs in tears and in sorts. The tears, styled in commerce *picked* mastich, are most esteemed, and vary in size and shape. They are of a pale-yellow color, of shining fracture, and translucent. The mastich in sorts occurs in masses and tears, is coarser and impure, containing many darker-colored tears, dirt, &c.

Mastich gives off, when rubbed, quite an agreeable terebinthinate odor; on chewing, it is at first friable, but soon concretes into a ductile mass. It is soluble in ether and oil of turpentine. Boiling rectified spirit dissolves nine tenths of its weight, leaving a white, tough, ductile substance undissolved.

The finer sorts of mastich are sometimes adulterated with *sandarach*, but this, when chewed, remains brittle, and does not concrete into a ductile mass. Mastich is also adulterated with *other resins*, but these may be known by their not acting as mastich does with boiling alcohol.

## MERCURIAL PILLS.

SYN. *Blue Pills; Pilulæ Hydrargyri.*

WHEN mercurial pills are prepared with conserve of roses, of which the color has been brightened by sulphuric acid, it will contain *sulphate of mercury*, an injurious contamination. This may be detected by rubbing the mass with boiling water, and testing the clear solution according to the *Baryta Test*. (See Appendix.)

The mercury is sometimes not sufficiently extinguished, and may be detected by the magnifying-glass.

Sometimes this preparation contains less than the due proportion of mercury, which should constitute one third of the mass, and this may be ascertained by the specific gravity, or more exactly by an assay for the metal. Sometimes it even contains clay admixed, which will be left behind on incineration.

## MERCURY.

SYN. *Quicksilver; Hydrargyrum.*

AT ordinary temperatures mercury is liquid, and has a lustrous silver-white color. Exposed to the air the surface soon tarnishes, if it is impure.

It is liable to be contaminated with many metals, such as *lead, tin, bismuth*, and sometimes *copper*.

When impure it easily tarnishes, and *wets* the sides of the vessel in which it is shaken. When pure it is entirely sublimed by heat, and a globule

moved along a sheet of paper leaves no trail ; on being boiled with pure muriatic acid, the clear liquid is neither colored nor precipitated by sulphuretted hydrogen or sulphide of ammonium.

#### MERCURY, AMMONIATED.

SYN. *White Precipitate; Ammonio-chloride of Mercury; Hydrargyrum Ammoniatum.*

THIS is a heavy, white, odorless powder, of an unpleasant metallic taste. It is entirely sublimed by heat, without charring, and is soluble in muriatic acid ; and these two tests are sufficient to detect any foreign substances with which it may be adulterated, such as *gypsum*, *white-lead*, *calomel*, *chalk*, and *starch*; the presence of calomel is indicated also by being blackened by lime-water.

#### MERCURY, BICHLORIDE OF.

SYN. *Corrosive Sublimate; Oxymuriate of Mercury; Muriate of Mercury; Hydrargyri Chloridum Corrosivum.*

CORROSIVE SUBLIMATE is met with in the form of a white, semi-transparent, crystalline mass, or as a white powder. It is inodorous, but has a very disagreeable, metallic taste. It fuses and boils on the application of heat, and sublimes without any residue. It is little soluble in water, more so in alcohol, and very soluble in ether. Its solution gives a yellow precipitate with the fixed alkalies, lime-water, and the alkaline carbonates, and a scarlet precipitate with iodide of potassium.

Corrosive sublimate seldom contains any impurity, but it is said to be sometimes adulterated with *calomel* or *sal ammoniac*; these may be detected by their insolubility in ether. Any fixed impurities may be determined by sublimation. When heated with a little slaked lime or a solution of caustic potassa, *sal ammoniac* will evolve ammonia, easily recognized by its odor, and by the fumes restoring the blue color of reddened litmus-paper.

#### MERCURY, BINIODIDE OF.

SYN. *Red Iodide of Mercury*; *Hydrargyri Biniodidum*.

THIS is a scarlet powder, which on the application of heat becomes yellow, then melts, sublimes, and condenses in fine yellow crystals, which slowly become red on cooling rapidly or applying friction. It is soluble in alcohol, and in a boiling solution of common salt, from which it is deposited in fine red crystals on cooling.

#### MERCURY, BLACK OXIDE OF.

SYN. *Protoxide or Suboxide of Mercury*; *Gray Oxide of Mercury*; *Hydrargyri Oxidum Nigrum*.

PROTOXIDE OF MERCURY, when pure, is of a grayish-black color, but it is very prone to decomposition, and is then yellowish or olive-colored. It is tasteless and inodorous, insoluble in water and in muriatic acid, but soluble in acetic and nitric acids. It entirely volatilizes on the application of a strong heat.

The impurities to be sought for are *metallic mercury*, *peroxide of mercury*, *calomel*, and *fixed substances*. The latter are not volatilized by heat. Metallic mercury is detected by its insolubility in acetic acid; peroxide of mercury, by its solubility in muriatic acid, and this solution giving a yellow precipitate with an excess of a solution of potassa; and calomel, by boiling it with a solution of potassa and testing the clear liquor, neutralized with nitric acid, with nitrate of silver for muriatic acid. (See *Silver Test.*)

#### MERCURY, BLACK SULPHURET OF.

SYN. *Ethiops Mineral*; *Sulphuret of Mercury with Sulphur*; *Hydrargyri Sulphuretum Nigrum*.

THIS is a heavy black powder, tasteless and inodorous; it is insoluble in water, and completely dissipates on being heated. This complete dissipation by heat, without incandescence, will show the absence of *charcoal*, *bone-black*, or *black-lead*, with all of which it is liable to be adulterated. *Sulphuret of antimony*, with which it is also sometimes adulterated, may be detected by boiling the powder with muriatic acid, when the clear liquor will give a white precipitate of chloride of antimony when dropped into water. If it contain free metallic mercury, it will produce a *white spot* on bright copper or gold, when rubbed on them.

## MERCURY, CYANURET OF.

SYN. *Cyanide of Mercury; Bicyanide of Mercury; Prussiate of Mercury; Hydrargyri Cyanuretum.*

THIS salt occurs crystallized in white rectangular prisms, transparent or opaque, inodorous, and of a metallic taste. It is soluble in water and alcohol. When drenched with muriatic acid it gives off the odor of prussic acid, and corrosive sublimate is left behind. It decomposes and volatilizes completely upon the application of heat, if the salt is pure.

## MERCURY, IODIDE OF.

SYN. *Subiodide or Protoiodide of Mercury; Green Iodide of Mercury; Hydrargyri Iodidum.*

THIS is a greenish-yellow powder, and is insoluble in water, alcohol, and in solution of common salt. By the application of heat, it is readily resolved into metallic mercury and the red iodide of mercury. It reddens when sublimed, and becomes yellow on cooling.

## MERCURY, PEROXIDE OF.

SYN. *Binoxide or Deutoxide of Mercury; Nitric Oxide of Mercury; Red Oxide of Mercury; Red Precipitate per se; Red Precipitate; Hydrargyri Oxidum Rubrum.*

RED OXIDE OF MERCURY is prepared in three ways, viz.:—1. *By the precipitation of corrosive sublimate with liquor potassœ.* As thus prepared it has a bright

orange-red color; when too little alkali is used, it has a brick-red color. 2. *By the calcination of metallic mercury.* The product thus obtained has the form of small brilliant scales of a ruby-red color. And 3. *By the calcination of nitrate of mercury.* By this method, which is the one ordered by the United States Pharmacopoeia, the red precipitate is in bright orange-red crystalline scales.

At about 400° Fahrenheit, red precipitate is decomposed into mercury and oxygen; it is slightly soluble in water, to which it communicates a metallic taste. Heat renders it first dark-red, then violet, and finally brownish-black, but the original color returns on cooling. It is entirely sublimed by a stronger heat. It is entirely soluble in muriatic acid. The impurities which have been detected in it are *nitric acid, red oxides of iron and of lead, and brick-dust.* The latter impurities are all left after sublimation, and ruddy fumes will be given off on heating if nitric acid is present.

#### MERCURY, PROTOCHLORIDE OF.

SYN. 1. *Calomel; Sublimed Calomel; Subchloride of Mercury; Mild Chloride of Mercury; Hydrargyri Chloridum Mite.* 2. *Calomel by Precipitation.*

CALOMEL, as obtained by sublimation, is sometimes in the form of a semi-transparent crystalline cake. When the mass is scratched it yields a yellow streak, which is characteristic. But calomel always occurs in the shops as a heavy, soft, inodorous and tasteless powder, of a snow-white or slightly

buff color. It becomes blackish or gray on exposure to solar light. Calomel is insoluble in water, alcohol, or ether. By long-continued boiling with water it is gradually resolved into corrosive sublimate and mercury. Exposed to heat, it first becomes yellow, and volatilizes at a higher temperature. Its specific gravity is 6.5.

Calomel may be recognized by turning greenish-yellow when digested in a solution of iodide of potassium, by being blackened by the caustic alkalies and by lime-water, and by giving, when treated with pure strong nitric acid, a white precipitate with nitrate of silver, soluble in an excess of ammonia. It is volatilized by heat.

Calomel is sometimes contaminated with small quantities of *corrosive sublimate* or *subnitrate of mercury*, and it is also adulterated with *chalk*, *sal ammoniac*, *common salt*, *sulphate of baryta*, and *white-lead*.

Corrosive sublimate may be detected by agitating the sample with ether, pouring off the clear liquor and evaporating; if any be present, a crystalline powder is left, which is rendered yellow with a solution of caustic potassa.

Subnitrate of mercury may be detected by treating the calomel with water slightly acidulated with nitric acid, and then testing the clear liquid with potassa, which will give a precipitate if any subnitrate has been dissolved.

Sal ammoniac and common salt may be recognized by the taste, and also by the watery solution yielding a residue on evaporation.

White-lead; chalk, sulphate of baryta, and the like

adulterations, may be recognized by the non-volatile residue which is left after ignition in a porcelain capsule.

Corrosive sublimate is the impurity most frequently met with in calomel. Great care should always be taken to detect it, because its presence very seriously changes the medicinal effect of the article.

#### MERCURY, RED SULPHURET OF.

SYN. *Vermilion; Cinnabar; Bisulphuret of Mercury; Hydrargyri Sulphuretum Rubrum.*

RED SULPHURET OF MERCURY is without odor or taste, and is insoluble in water, alcohol, or ether. It is inflammable, burning with a blue flame and a sulphurous odor, and is completely volatilized by heat. Good vermillion has a powerful vivid color, and is of great body, weight, and opacity. "The Chinese possess a native cinnabar so pure as to require grinding only to become very perfect vermillion, not at all differing from that imported in large quantities from China. Chinese vermillion is of a cooler or more crimson tone than that generally manufactured from factitious cinnabar in England, Holland, and different parts of Europe." (Rudiments of the Painter's Art, by Field.) Chinese vermillion is closely imitated by manufacturing the article in the moist way, instead of by sublimation.

Vermilion is very much adulterated with *red-lead, subchromate of lead, chalk, carbonate of magnesia realgar, red oxide of iron, dragon's-blood, &c.*

The inorganic impurities, except realgar, are determined by sublimation; dragon's-blood, by coloring alcohol red, and by being charred by heat; and realgar, by giving off the odor of garlic when a sample is thrown on red-hot charcoal. Realgar may also be detected by boiling a portion of the sample in potassa, neutralizing the clear liquor with muriatic acid, and then adding to it some sulphuretted hydrogen, which, in case of its presence, will give a yellow precipitate. Lead impurities are distinguished from the others, by giving globules of lead on charcoal before the blowpipe.

It will perhaps be interesting to give some results obtained by Mr. Henry Brown, at the Lawrence Scientific School, on samples of vermillion procured in Boston, and which probably indicate, according to the "Annual of Scientific Discovery" for 1851, the average purity of this article as ordinarily sold.

No. 1. Trieste Vermilion, was pure.

" 2. "	"	"	"
" 3. "	"	"	contained 14.94 pr. ct. of carb. of magnesia.
" 4. "	"	"	26.57    "    "    "
" 5. "	"	"	was pure.
" 6. French	"	"	" - .
" 7. "	"	"	contained 35.87 pr. ct. of sulphate of lime.
" 8. Chinese	"	"	62.36    "    of chromate of lead.
" 9. "	"	"	48.12    "    "    "
" 10. American	"	"	100.00    "    of red-lead.

The chromate of lead, spoken of in the above analysis, must have been a *basic* chromate of lead, which acts very differently from the chromate of lead with acids and fixed alkalies.

## MILK.

SYN. *Lac.*

THE quality of milk is in a great degree known by its taste and color. It should be sweet and of good flavor, and should present a delicate cream-colored tint. When bluish, it should be suspected of having been fraudulently treated, or having been given by an inferior cow. Milk that is in the least degree sour curdles with tea or coffee, and cannot be boiled without separating into whey and curd.

The two principal frauds to which milk is subjected are *the deprivation of its cream by skimming, and watering.* It is also said to be adulterated with *starch, flour, yolk of eggs, turmeric, chalk, &c.,* but these latter adulterations are hardly practicable. *Bicarbonate of soda* is sometimes added to restore sour milk. Regnault says, "The *turning* of the milk may be prevented, without injuring its quality, by adding two or three thousandth-parts of bicarbonate of soda."

The most certain way of testing the quality of milk is to separate it into its proximate elements; but as only a few of those for whom this work is designed would attempt this, we will merely refer them for proper processes to Stöckhardt's "Principles of Chemistry," "Cours de Chimie, par Regnault," Mitchell "On Falsifications of Food," &c.

The amount of water may be determined by evaporating a weighed portion to dryness over a water-bath; the residue should not amount to over 11 or 12 per cent., the loss being water; and the ashes,

which should not amount to over one per cent. at most, may be determined by incinerating the above residue; any excess over one per cent. is an inorganic adulteration.

The abstraction of cream is found out by means of the *Lactometer* or *Creamometer*. This instrument consists of a glass tube, eight or ten inches in height and about an inch in diameter. It is graduated from above downwards into 100 parts, 0° being at the top. The milk to be examined is poured in up to this mark, and is then left for twelve or twenty-four hours, when the thickness of the stratum of cream is observed. Soubeiran says, that "all milk which does not yield 11 or 12 per cent. by volume of cream may be considered as having been skimmed."

A rough method, used in the German cities by the inspectors of milk, for testing the amount of *watering*, is to dip an iron rod tapering to a point into the milk as it is brought in from the country, and then observing the greater or less transparency of the drop which falls from the end of this rod as it is held up to the light. If the drop is too transparent, the inspector, without much ado, thrusts his rod through the bottom of the earthen vessel in which the milk is conveyed, and lets it flow into the street.

The same principle of testing milk by its degree of opacity is applied accurately by means of a small instrument called a *lactoscope*, which consists of two plates of glass, between which a layer of milk is contained, the milk being better the thinner the layer required to prevent the light passing through it. For

a description of this instrument, I must refer to the work of Regnault quoted above, and to the "Traité de Pharmacie, par Soubeiran." The value of milk may also be determined by the amount of butter it will yield. Soubeiran says a quart of good milk should yield about one ounce of butter.

*Flour or starch* is indicated by giving a blue coloration with tincture of iodine. Milk should not be kept in lead or zinc vessels, as it readily dissolves both of these metals.

#### MORPHINE, SALTS OF.

Most of the salts of morphine are crystallizable, have a white color, and a very bitter taste, and are generally soluble in water and in alcohol, but insoluble in ether. They are precipitated by the caustic alkalies and by ammonia or lime-water, the precipitate being soluble in an excess of ammonia, of which a large amount is, however, required. An infusion of nut-galls precipitates the salts of morphine, like those of all other alkaloids. Iodic acid is decomposed, and iodine set free, as shown by the brown tinge which is produced. They strike a blue color with neutral salts of peroxide of iron. Perchloride of gold forms with them a yellow precipitate, which passes over to blue. Nitric acid imparts to them a blood-red color, which rapidly changes to yellow.

\*The salts of morphine which are most used in medicine are the *sulphate*, the *muriate*, and the *acetate*; the sulphate of morphine is distinguished from the others by the *baryta test*; the muriate by the *sil-*

*ver test*; and the acetate by giving off the odor of vinegar when drenched with sulphuric acid.

Pure sulphate of morphine, according to Liebig, contains 10.33 per cent. of sulphuric acid, 75.38 of morphia, and 14.29 of water; it consequently should yield, with chloride of barium, 31.13 per cent. of sulphate of baryta. The composition of muriate of morphine is said to be 76.24 per cent. of morphia, 9.66 of muriatic acid, and 14.1 of water; if this is correct, it should form, with a silver solution, 38.04 per cent. of chloride of silver.

The principal impurities as yet recognized in the salts of morphine are *excess of moisture, coloring and resinoid matter, narcotine, and sugar*. The sulphate, when pure, does not lose over 9.66 per cent. of water at  $248^{\circ}$ , and the chloride should not lose at a heat of  $212^{\circ}$  more than 13 per cent. The salts of morphine will not be of a pure white color if they contain coloring or resinoid substances; these can be recognized by recrystallization from water; the mother liquors will remain colored. Narcotine is best determined by the action of solution of potash, which, while it readily dissolves morphia, leaves narcotine unattacked. Ether dissolves the narcotine, and not the morphine. Pure salts of morphine should leave no residue on incineration. As these morphine salts are so expensive, it is not improbable that they are sometimes adulterated with other cheaper vegetable alkaloids, the presence of which it would be difficult for the analytical chemist to detect. Sugar can probably be best detected by precipitating the aqueous solution of the salt of morphine with ammonia,

filtering and washing. The filtrate is to be evaporated down to a small volume over the water-bath, when the sugar will remain behind in form of syrup.

## MUSK.

SYN. *Moschus.*

Musk is a peculiar concrete substance, obtained from the musk-deer, and has a most penetrating and diffusive odor, rather agreeable when feeble, but when concentrated decidedly offensive. The taste is bitterish and somewhat acrid, and the color is reddish-brown, resembling dried blood. It is imported from China, Bengal, and Russia. Tonquin musk is the most esteemed. *Pod musk* is the natural bag containing the musk, which latter is called *grain musk*, the bag and contents weighing about six drams, and the musk it contains about eight scruples.

Musk is very generally adulterated, for which purpose *dried bullock's-blood*, *chocolate*, *asphaltum*, or some *dark friable earth*, is used.

Every true musk-bag contains an aperture in the middle of the hairy portion; if this is wanting, the bag is spurious. The bags should also be closely examined to see if they have not been opened, and afterwards stitched together again or glued.

Dried blood may be known by its omitting a fetid vapor, like burnt hair, on burning; asphaltum melts before it inflames, whereas musk chars only; chocolate and earthy impurities can be detected by their insolubility in ether. The ashes of musk, after incineration, should not exceed five or six per cent.

Normandy gives the following as the chemical tests of the purity of musk. "It should dissolve in boiling water, and leave only one fourth of its weight in an insoluble state, and the boiling solution should be precipitable by acids, and more particularly by nitric acid, so as to become almost colorless; a solution of acetate of lead, and that of galls, should likewise precipitate it; but one of corrosive sublimate should not create the slightest precipitate or turbidness."

In a work entitled "Perfumery," edited by Mr. Morfit, it is stated that "the pods containing the musk should be dry and very fine, garnished with a slightly brown hairy nap; such characteristics prove the musk to be of good quality Tonquin, whilst a whitish down indicates an inferior article of Bengal. A good test of the quality is to perforate the pod with a wire which has been dipped in the juice of garlic, the dissipation of the smell of which proves the musk is not adulterated."

#### MYROBALANS.

THESE are a dried fruit of the plum kind, brought from Bengal and other parts of India. They are shrivelled, and vary in size from that of olives to gall-nuts. They have a styptic taste, and form with iron a strong black ink.

#### MYRRH.

SYN. *Myrrha.*

MYRRH is met with of different qualities. *Turkey myrrh* is the finest, and occurs in pale brownish-yel-

low fragments, while *India myrrh* is inferior, and comes in dark brownish-red pieces. It has a bitter taste and a balsamic odor.

Myrrh is often adulterated with *inferior myrrhs*, *bdellium*, and *other gums*, but the finer sorts only should be used in medicine.

Giovanni Righini says: "To ascertain the purity of myrrh, triturate a small quantity of the powder of the suspected myrrh with an equal amount of muriate of ammonia, adding water gradually; if the whole is readily dissolved, the myrrh is true; otherwise it is sophisticated with some other substance." (Cooley.)

#### NITRIC ACID.

SYN. *Azotic Acid*; *Spirit of Nitre*; *Aqua-fortis*; *Acidum Nitricum*.

AQUA-FORTIS is a dense, colorless liquid, with a powerful, disagreeable odor, and an intensely acrid, caustic taste. When concentrated, it emits white, irritating fumes, and if poured on to metallic copper it gives off brownish-yellow fumes of a nauseous, irritating smell. It stains the skin yellow. Whether concentrated or diluted, it turns morphia red, decolorizes sulphindigotic acid, and forms a dark halo around a crystal of protosulphate of iron placed in it. The nitric acid of the shops is generally yellowish, owing to the presence of *nitrous acid*; this may be recognized by its property of decolorizing manganate of potassa. It is also almost always contaminated with *sulphuric* and *hydrochloric acids*, *chlor-*

*rine*, and *chlorides*. Sulphuric acid is shown by nitrate of baryta (see *Baryta Test*), and the other impurities by the *Silver Test*. Before testing the acid with these reagents, it should be highly diluted with *pure* water.

Pure nitric acid must be colorless, and leave no residue when evaporated to dryness on a watch-crystal. To determine the strength of the acid, see "*Acidimetry*."

*Iodine* is said to be present in the nitric acid prepared from Chili saltpetre. Saturate it with soda, and test for it by the *Starch and Iodine Test*.

#### NITRO-MURIATIC ACID.

SYN. *Aqua-regia*; *Acidum Nitromuriaticum*.

THIS acid has a deep yellow color, and exhales an odor both of chlorine and nitrous acid. It is readily distinguished from all other acids by its property of dissolving gold and platinum.

The proportion of the constituent acids varies for different purposes. It is generally prepared extemporaneously just before using it, and is seldom kept ready made. If concentrated, it would, on keeping in a warm place, be partially decomposed.

#### OILS, FIXED.

SYN. *Fat Oils*; *Unctuous Oils*; *Expressed Oils*; *Olea Fixa*.

THESE oils vary in consistency from that of tallow to perfect fluidity, and have, when pure, but little

smell or taste; their color is generally yellowish. Their specific gravity is less than that of water, and ranges between .913 and .936. They leave a greasy spot on paper, which renders it transparent, and which is not removed by the application of heat. They differ in their freezing points, olive oil being easily congealed, while linseed oil requires a very low temperature to freeze it. Those oils which lose their unctuous feeling on drying are called *drying oils*. They are all insoluble in water, very sparingly soluble in alcohol (except castor oil), and readily soluble in ether.

The purity of the fixed oils is best ascertained by the specific gravity, and by the odor and taste. The odor may be observed in the cold; or a few drops of the oil may be poured into a porcelain capsule and heated over a spirit-lamp. In this way impurities may often be readily detected, but the observation should be made in conjunction with a genuine oil. The action of sulphuric acid on the oils has also been proposed as a test of the purity of the different oils. If fifteen or twenty drops of the oil under examination are dropped on a watch-glass placed upon a sheet of white paper, and then there is added one small drop of sulphuric acid of specific gravity 1.632, a color peculiar to each different oil will be produced. The observation may be made either with or without stirring. A *standard* oil should be used simultaneously in this experiment. But this is a very delicate operation, and I doubt if it would be practicable except in the hands of a very experienced observer. I must refer those who would

wish to know more of this test to Normandy's Hand-Book of Commercial Analysis.

## OILS, VOLATILE.

SYN. *Essential Oils; Distilled Oils; Olea Volatilia.*

"THE volatile oils are either solid or liquid; their density is sometimes greater and sometimes less than that of water, varying from .759 to 1.096. They vary in color; this, however, strictly speaking, does not belong to them, but appears to be owing to some foreign substances which they hold in solution. They have a pungent taste, and a strong odor, which proceeds from the plants which yield them. They are very inflammable, and burn with a fuliginous flame; at usual temperatures they absorb oxygen, which alters their character, so that they should be kept in well-closed bottles. They should also be kept in the dark,—the light coloring and altering them. Water dissolves a minute quantity of them; alcohol is a good solvent, and dissolves them the better the more concentrated it is; the more oxygenated oils are the most soluble; they are also soluble in spirits of turpentine and in fixed oils, in acetic and other vegetable acids." Soubiran. These oils leave no greasy stain on paper after being heated.

The volatile oils are often adulterated, and some of them are hardly ever to be found pure. The principal adulterations are the *fixed oils*, *castor oil*, *spermaceti*, *resins*, *balsam copaiva*, *alcohol*, or *cheaper essential oils*. All the adulterations but the two latter

may be detected by their leaving a transparent, greasy stain on paper, which is not expelled by heating the paper. All the fixed oils, also, excepting castor oil, remain undissolved when the oil is agitated with thrice its volume of alcohol. Alcohol may be detected by agitating the oil with a piece of chloride of calcium, which will dissolve if much alcohol is present, and will have its form altered if less is present. Another test for alcohol is the milkiness produced in the oil by the addition of water. To detect the presence of the cheaper oils, rub a little in the palm of the hand, or pour a drop or two on porous paper and shake it in the air, when the odor of the inferior oil will manifest itself. *Spirits of turpentine* may be detected by shaking the oil with spirits of wine, when it will remain mostly undissolved. The purity of essential oils may also be detected by their specific gravity, or by measuring their index of refraction. When oils are mixed, of which one is heavier and the other lighter than water, they will separate on being agitated with water.

## OPIUM.

OPIUM is the concrete juice of the *Papaver somniferum*. Several varieties of it occur in commerce, such as *Turkey opium*, including *Smyrna* or *Levant*, and *Constantinople opium*; *Egyptian* or *Alexandrian opium*; *East Indian opium*, including the *Bengal*, *Garden Patna*, and *Malwah opiums*; and *Persian opium*. But the *Smyrna opium* is that which is chiefly brought into this country. It comes in large, flat,

circular cakes or round balls, covered with rumex-seeds and fragments of leaves, and packed in cases. Its interior color is fawn or brown. According to Soubeiran, it is the best of opiums, and contains from six to nine per cent. of morphia.

*Constantinople opium* is imported in cases, and is made up into cakes and balls like the Smyrna opium, but generally very much smaller, and these are covered with poppy-leaves, the midrib of which seems to divide them into halves. They are not generally covered with rumex-seeds, though a case has come under my inspection in which these seeds were present. Of the samples which I have seen, some were darker and others lighter colored than the Smyrna opium, and all were more homogeneous in appearance. Soubeiran states that it contains about 5 or 6 per cent. of morphia, and two samples which I analyzed gave 6.2 and 4.0 per cent. of impure morphia; but it was exceedingly difficult to work them, owing to the amount of gummy matter contained in them, clogging up the filters; indeed, I found it impossible for this reason to analyze them accurately.

The *Egyptian* or *Alexandrian opium* does not occur, as far as I am aware, in our commerce. Soubeiran states that "it is the worst species of opium; it is always in small cakes, which are very dry and flat, and present a very clean surface, retaining only traces of the leaves in which they had been wrapped; its color is dark brown, and its fracture smooth and shining; it has a very feeble odor, and contains only 3 or 4 per cent. of morphia."

*East Indian opium* being nearly all consumed in

China for smoking, but very little, if any, is brought to this country. According to Christison, *Bengal opium* is the most inferior of the East Indian opiums. "It is made up in nearly round balls, not unlike in size and general appearance to a rusty twenty-four-pound shot. These consist of a case about half an inch thick, formed of tobacco leaves and agglutinated poppy-petals, and filled with a black, pitch-like mass, which is soft enough, even when some years old, to be taken out with a spatula." *Garden Patna opium* occurs in flat cakes, from three to four inches square and about half an inch thick. It is enveloped in thin plates of mica. It has a reddish-brown color, and is homogeneous throughout. Christison says that he "has examined specimens little inferior to average Turkey opium in the quantity of morphia they contained." *Malwah opium* is in flat, roundish cakes, five or six inches in diameter, and weighing from four to eight ounces. It is hard and brittle, covered with a coarse grayish dust, with a shining light-brown fracture. "It is probably but little, if at all, inferior to the Garden Patna opium." *Persian opium* occurs in cylindrical sticks, about six inches long and half an inch in diameter. It is represented as being an inferior article. Wood states that it has occasionally, though rarely, found its way to this country, and that a parcel imported into New York yielded only three per cent. of morphia.

*European opium* is also cultivated.

Good opium smells heavy and narcotic, and has a disagreeable, bitter taste. It is of a deep rich fawn or brown color, and of a compact structure. Its specific

gravity is 1.336, few vegetable products being so heavy. But the most important test of the quality of opium is that which informs us of the amount of morphia contained in it. Good opium, according to Wood and Bache, should yield 10 or 12 per cent. of the *impure* morphia, as prepared by the method given in the United States Pharmacopœia. Christison states that he has not been able to obtain by any process above 9 per cent. of perfectly *pure* morphia from the finest Smyrna opium. He also states that the Garden Patna opium yielded him 6.5 per cent. of perfectly pure morphia, and says that Persian opium yielded Merck only 1 per cent. Mérat, in the Supplement to the "Dictionnaire de Matière Médicale de MM. Mérat et De Lens," states that the East India opium prepared for the Chinese market contains only  $\frac{1}{2}$  per cent. of morphia, and that the medical Patna opium contains 10 per cent. He also says that Constantinople opium contains 5 per cent. of morphia, Egyptian opium 7 to 8, and Smyrna opium 10 per cent. He states, moreover, that Caventon obtained from opium cultivated in the department of Landes, in France, 14 and 22, and even higher percentages of morphia.

My analyses of different Smyrna opiums, performed by Mohr's method, which I shall presently describe, gave me of impure morphia 7.47, 9.00, 9.20, 8.93, 10.66, 9.26, 8.87, 12.66, 8.7, 10.79, and 13.33 per cent. This impure morphia was found by Dr. Linck to lose on purification two fifths of its percentage weight, and to yield the pure salts in the same proportion. It is worthy of observation, that many of

the analyses given by different authors seem to relate to a yield of more or less impure morphia, and it is a matter of regret that there is not always sufficient clearness on the point in the statements of the different manipulators.

I now propose to describe Mohr's method, as practically applied by myself. I take fifteen French grammes of opium (about half an ounce, apothecaries' weight), and let it macerate with an ounce and a half of cold water for twenty-four hours, when it should be strained through cotton cloth and strongly expressed. This operation is to be repeated twice, but the second maceration need last but six hours, and the third but three. A thick milk of lime is now to be prepared with four grammes (about one dram) of quicklime, and the above infusion is to be added to the milk of lime when boiling hot, and boiled for about five minutes, and then strained through cotton cloth, and the residue washed with boiling water and expressed. This liquor is then reduced by evaporation to about one fluid ounce, filtered rapidly though paper, and then heated to boiling; one gramme (about one scruple) of muriate of ammonia is then to be added, when the *impure* morphine is precipitated. After from six to twelve hours, it is to be collected on a weighed filter, dried by a gentle heat, and weighed. This morphine may be purified by dissolving in diluted hydrochloric acid, again boiling with milk of lime, filtering, and reprecipitating by sal ammoniac.

Another method of good application is that given in the United States Pharmacopœia, to which I

must refer; but the morphine thus prepared contains *narcotine*, which is not the case when it is prepared by Mohr's method.

Opium is very extensively adulterated with *sand*, *earths*, *stones*, *shot*, *leaves*, *bruised grapes*, *vegetable extracts*, &c. But the only sure method of judging of its quality is to estimate the amount of morphia contained in it.

#### OXALIC ACID.

SYN. *Acid of Sugar*; *Acidum Oxalicum*.

OXALIC ACID crystallizes in oblique quadrilateral prisms, with dihedral summits; it is inodorous and has a very acid taste, and is soluble in eight parts of cold, and its own weight of boiling water; it is also very soluble in alcohol. It effloresces in dry air, and sublimes at  $350^{\circ}$  F., with partial decomposition.

The oxalic acid of commerce is not always pure, but is liable to contamination with *inorganic salts*, *nitric* and *nitrous acids*, *sulphuric acid*, and some of the *intermediate products* which precede it during its manufacture from sugar. In the latter case it blackens when it is warmed in a tube closed at one end, whilst, if pure, it would partially sublime without blackening. Sulphuric acid is detected by the *Baryta Test*; nitric and nitrous acids are tested for by boiling the sample with dilute sulphindigotic acid, which will be discolored if they are present; if any residue is left after calcination, inorganic salts are present. *Racemic acid*, which reacts on a solution of gypsum like oxalic acid, may be distinguished from

it by being blackened by sulphuric acid, and by giving off the odor of *caramel* on calcination.

"Oxalic acid is also easily distinguished," says Soubiran, "from all other vegetable acids resembling it, by precipitating lime from all of its solutions and by reducing chloride of gold." Pure oxalic acid is also the only non-volatile acid which does not blacken upon its destruction by heat. It burns up completely, however. It yields with lime-water, and even sulphate of lime, a white precipitate, which is insoluble in acetic acid, but readily soluble in mineral acids.

Oxalic acid, when heated with oil of vitriol, evolves copiously a mixture of protoxide of carbon and carbonic acid, which, when inflamed, burns with a characteristic blue flame. If the oxalic acid is pure, the oil of vitriol will not be blackened during the decomposition. The common commercial article, however, generally blackens somewhat, but not near so much as do the other organic non-volatile acids.

#### PALM OIL.

SYN. *Coci Butyraceæ Oleum Fixum.*

PALM OIL has a fine orange color, is of a butyra-ceous consistency, and smells of violets or orris-root. When heated to 266° F. it becomes bleached. It is used to make soap, candles, and ointments. It is often mixed with *sticks, sand, &c.*, which may be determined by heating the oil, straining it, and washing the residue with *boiling* water, or, better, with ether. This residue may then be weighed, or the amount of impurities may be approximately esti-

mated by heating the oil in a glass test-tube, when the impurities will settle to the bottom. We find in Normandy's work the following remark: "It is stated in various books that palm oil is sometimes imitated with hog's lard, colored with turmeric, and scented with Florentine orris-root. It is hardly possible that such a fraud can be practised, seeing that hog's lard is double the price of genuine palm oil."

## PAPER FOR FILTERING.

SYN. *Bibulous Paper.*

"To be perfect, filtering-paper ought to combine the three following properties:—1. It should completely retain even fine precipitates; 2. It should filter rapidly; and 3. It should be as free as possible from any admixture of inorganic bodies, but more especially from such as are soluble in acid or alkaline fluids. *Swedish filtering-paper* is the best.\* It is not very easy, however, to procure the article genuine, since many of the papers sold under this name are of greatly inferior quality, with respect to their filtering capacity, as well as with regard to their purity, containing, as they do in many instances, perceptible traces of lime, magnesia, and iron; and leaving upon incineration about 0.3 per cent. of ashes, which is considerably more than the genuine article does.

"It is advisable, therefore, to treat filtering-paper

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\* Swedish filtering-paper is very expensive, costing at least twelve cents a sheet. The common German filtering-paper is very good, and answers every purpose in all ordinary analyses.

intended for *minute* experiments with hydrochloric acid, in order to free it from the inorganic substances which it may contain; the paper is subsequently carefully washed with water, to remove every trace of the acid, and finally dried, when it may be considered fit for use." — Bullock's Translation of Fresenius's Quantitative Analyses.

## PEPPER.

SYN. *Black Pepper*; *Piper Nigrum*. *White Pepper*;  
*Piper Album*.

BLACK PEPPER is of the size of a small pea, somewhat wrinkled, and covered with a dark tegument. It should have a pungent, fiery, aromatic taste; and those which are shrivelled should be rejected.

*White pepper* has the same taste and odor as the black pepper, but in a milder degree. Mitchell states that there is "a native species of white pepper, which is little, if any, inferior in flavor and pungency to the black; it is seldom met with."

M'Culloch says, "In point of quality the pepper of Malabar is usually reckoned the best, but there is no material difference between it and that of Sumatra and the other islands."

Pepper is adulterated to a great extent, but more especially when in the state of powder, this being mixed with *husks of mustard*, *oil cake*, *linseed meal*, and *earthy matters*. The latter are easily detected by incineration. Organic impurities are best detected by the eye and the taste, or by estimating the amount of *piperine* contained in it, as follows.

Treat two ounces of the pepper with alcohol, then evaporate the solution to the consistency of an extract, and pour upon it a solution of caustic potassa, which dissolves all but the piperine. This may be purified by many crystallizations from alcohol, in which it is very soluble. Normandy says, that "good pepper yields about 1½ per cent. of piperine."

But pepper is not only adulterated in the powdered form, but even, it is stated, in the form of grains, or peppercorns. These are made of *a paste of flour, mustard, cayenne pepper, and other pungent powders*; but the fraud is easily detected by throwing them into hot water, when the factitious peppercorns will fall to pieces, while the genuine will retain their form.

#### PHOSPHORIC ACID (DILUTED).

SYN. *Acidum Phosphoricum Dilutum.*

THIS is a colorless, inodorous, transparent liquid, with an extremely acid taste. The London tests are: "The precipitate it forms with chloride of barium or nitrate of silver is easily dissolved by nitric acid. It does not affect a [bright] plate of silver or copper [if nitric acid, however, is present, these metals are dissolved], and is not affected by sulphuretted hydrogen. Its density is 1.064. One hundred grains saturate forty-two of carbonate of soda, and no precipitation takes place."

## PHOSPHORUS.

PHOSPHORUS is soft and flexible, like wax, in summer, but is hard and brittle at the freezing temperature. When perfectly pure it is nearly colorless and translucent, but most generally it has a yellow tinge. It is exceedingly inflammable, and must therefore be kept under water, in which it is insoluble. It is sparingly soluble in ether, naphtha, and the oils, and very soluble in sulphuret of carbon. It has an alliaceous odor.

Phosphorus is sometimes contaminated with *arsenic*, *antimony*, and *sulphur*. To detect them, dissolve cautiously a small portion of it in nitric acid, and test for the sulphur, which will be converted by the acid into sulphuric acid, by the *Baryta Test*, and for the antimony and arsenic by the *Arsenical Test in presence of Antimony*. (See Appendix.)

## POTASSA.

SYN. *Potash*; *Hydrate of Potassa*; *Fused Potassa*; *Caustic Potash*; *Pure Potash*; *Alcoholic Potassa*; *Protoxide of Potassium*; *Kali*; *Pure Lixivium*; *Lapis Infernalis*; *Cauterum Potentiale*.

Two varieties of caustic potassa are prepared, the caustic potassa of pharmacy and that designed for chemists' use. The latter must be absolutely pure, and perfectly white. It should not effervesce with an acid, and when supersaturated with nitric acid, should give no precipitate with nitrate of baryta or nitrate of silver. The solution of it neutralized with

muriatic acid and evaporated to dryness should leave no residue of *silica* behind, when treated with water. It should not be rendered turbid on being heated with an equal volume of a solution of muriate of ammonia.

But the caustic potassa of pharmacy is generally of a bluish-gray color,—though I have met with it perfectly white in the shops,—and occurs either in plates or cylindrical pencils. It usually contains *alkaline sulphates* and *muriates*, *oxide of iron*, *silica*, and sometimes *alumina*. These contaminations may be detected by the method given for testing potassa for chemists' use.

Potassa is inodorous, and has a very caustic taste; it is fusible below red heat; it is soluble in water and in alcohol. It is very deliquescent, and in the state of solution rapidly unites with the carbonic acid of the atmosphere. It has a soapy feel, and is a powerful escharotic of the animal tissues. A *solution of potassa*, *liquor potassæ*, is ordered by the United States Pharmacopœia, and should be of the specific gravity of 1.056.

Potassa may be recognized by imparting a violet tint to the alcohol-flame. It forms, also, a precipitate with an excess of tartaric acid. By these two tests it may be distinguished from *soda*.

#### POTASSA, ACETATE OF.

SYN. *Foliated Earth of Tartar*; *Potassæ Acetas*.

THIS salt crystallizes in small, acicular, satiny prisms, is white, and has a fresh, cooling taste. It

deliquesces rapidly in the air, forming an oily-looking liquid, and is very soluble both in water and alcohol. When treated with sulphuric acid, it disengages fumes of vinegar. It is converted by red heat into carbonate of potash, which effervesces on the addition of an acid. It should not affect litmus or turmeric paper.

It is not now liable to adulteration, though it is stated to have been formerly adulterated with *sulphate and tartrate of potassa* and *chloride of potassium*; the former is detected by the *Baryta Test*, the latter by the *Silver Test*, and the tartrate by its insolubility in alcohol. Any contamination with *lead* and *copper* is detected by sulphuretted hydrogen forming with them a black precipitate.

#### POTASSA, BICARBONATE OF.

SYN. *Potassæ Bicarbonas.*

It occurs in transparent, colorless crystals, the primary form of which is a right oblique-angled prism. It is inodorous, but has a mild, alkaline taste. It is soluble in four parts of water at  $60^{\circ}$ , and in less than its own weight of boiling water, but then with partial decomposition; the solution is feebly alkaline. It is insoluble in alcohol. Heat expels part of its carbonic acid, even when the salt is in solution in water below the temperature of  $212^{\circ}$ .

The usual adulterations or impurities of bicarbonate of potassa are *sulphate*, *muriate*, and *carbonate of potassa*. If, in a solution supersaturated with nitric acid, nitrate of baryta gives a white precipitate,

a sulphate is present; and if nitrate of silver gives a white precipitate soluble in ammonia, a muriate is present. Carbonate of potassa is best detected by the action of corrosive sublimate on a solution in forty parts of water; if the salt contains even a trace of the carbonate, a brick-red precipitate is produced. Sulphate of magnesia should not give a precipitate with bicarbonate of potassa. Bicarbonate of potassa should leave no insoluble residue on treatment with a sufficiency of water. Good crystals of this salt are generally perfectly pure and reliable.

#### POTASSA, BICHROMATE OF.

SYN. *Potassæ Bichromas.*

THIS salt, so much used in calico-printing, occurs in orange-colored crystals, soluble in water, but insoluble in alcohol.

Bichromate of potash sometimes contains small crystals of *sulphate*, which can be discovered by the eye, and the sulphuric acid is also revealed by the *Baryta Test*. If the precipitate of sulphate of baryta is collected and weighed, the quantity of sulphate of potassa can be deduced by calculation, four parts of sulphate of baryta corresponding nearly to three parts of sulphate of potash.

This salt sometimes also contains a small quantity of *chromate of oxide of chromium*, which gives the crystals a darker color than the pure article possesses. If such a bichromate be dissolved in cold water, and the solution be filtered through a small filter of perfectly white (best Swedish) filtering-pa-

per, and this filter be washed until the wash-water passes through colorless, and then dried, that substance will be seen on it as a brown powder. We hardly think, however, that it can be injurious in any of its applications.

#### POTASSA, BINOXALATE OF.

SYN. *Salt of Sorrel; Essential Salt of Lemons;*  
*Sal Acetosellæ.*

THE salt of sorrel of commerce occurs in white crystals.

When pure it should yield nothing but carbonate of potassa on being heated, for the purity of which, see *Carbonate of Potassa*.

If adulterated with *cream of tartar*, on being heated it will be charred, and will evolve the peculiar odor of burning sugar.

The presence of *bisulphate of potassa* may be recognized by dissolving a portion in water, adding muriatic acid, and then testing with chloride of barium, which will give a white precipitate.

In order to determine whether the salt under examination is *binoxalate* or *quadroxalate of potassa*, proceed as follows. Ignite three parts by weight (for instance twenty-four grains) of it in an iron, platinum, or silver crucible, or small spoon, until it is completely decomposed, when it will fuse without any effervescence. Then dissolve it in water, and pour it into a small porcelain dish. Heat gently, and then add to it a sufficient portion of the same oxalate, from a weighed quantity, completely to neu-

tralize the liquid, or just enough to make it feebly acid. If the salt was binoxalate of potassa, three parts, or twenty-four grains, would be required for neutralization; but if it was quadroxalate of potassa, it will require only one part, or eight grains. If it was a mixture of both, a quantity between one and three parts (between eight and twenty-four grains) will be required for neutralization.

#### POTASSA, BITARTRATE OF.

SYN. *Cream of Tartar; Crystals of Tartar; Potassæ Bitartras; Potassæ Supertartras.*  
*Tartar; Crude Tartar; Argol; Wine-stone; Potassæ Bitartras Impurus.*

ARGOL is the hard crust which forms on the sides of casks in which new wine has been kept. It is red or grayish, according to the color of the wine, and is denominated either *red*, *brown*, or *white* argol, the latter being the most esteemed. Argol contains, as impurities, *tartrate of lime*, *coloring matter*, and other accidental impurities. "The marks of good argol are its being thick, brittle, hard, brilliant, and little earthy." The term *tartar*, either *red* or *gray*, is often applied to partially refined argols.

Argol, after undergoing a process of purification, is called *cream of tartar*. This occurs in commerce in white crystalline crusts or masses; but it is found most generally pulverized in the shops of the apothecaries and grocers. In crystals it is hard and gritty under the teeth, and dissolves slowly in the mouth. Cream of tartar is white, and has an acid taste. It

is sparingly soluble in water, but becomes abundantly soluble by the addition of borax. It is insoluble in alcohol. Heat chars and decomposes it, a peculiar odor being at the same time emitted.

Cream of tartar, especially in the state of powder, is very subject to adulteration. The substances commonly employed for this purpose are *sand*, *clay*, *marble*, *alum*, *gypsum*, *bisulphate of potassa*, and *wheaten flour*, *rice*, or *starch*.

To test cream of tartar for the above substances, put a small quantity of it in a small porcelain dish, and add to it about three or four times its weight of water, and stir for some time. If the cream of tartar is pure, it will communicate hardly any perceptible taste to the water; should it, however, contain bisulphate of potassa, the water will have a strong acid taste, and will act on the teeth.

Should the water have no such acid taste, heat it to near boiling with constant stirring, and add water of ammonia, until the liquid reacts somewhat alkaline after continued boiling. If starch or flour was present, it will form a paste as soon as the liquid becomes hot, and the presence of these, as well as of rice, may be confirmed by the *Starch and Iodine Test*. (See Appendix.) It should be borne in mind that starch, when boiled some time with cream of tartar alone, is converted into gum; the reaction for starch should therefore be observed in this case after a short application of heat. If no starch nor any other impurity is present, the cream of tartar will be completely dissolved with the aid of ammonia, neutral tartrate of potassa and ammonia being formed, which is easily soluble in water.

If sand, clay, gypsum, or marble is contained in the sample, it will be left undissolved, and these substances can, if required, be recognized by their proper tests. If alum is the adulteration, the ammonia in the alkaline solution will decompose it, and produce a gelatinous precipitate of alumina. An inexperienced manipulator might possibly not be able by its appearance to distinguish it from starch, but alumina does not exert the characteristic reaction that starch does with tincture of iodine. This alumina precipitate, when collected on a filter and washed with water, will easily dissolve in a solution of caustic potassa.

#### POTASSA, CARBONATE OF.

SYN. *Potassæ Carbonas.*

CARBONATE OF POTASH occurs as a white granular powder, is caustic and alkaline to the taste, and very deliquescent. It is very soluble in water, but insoluble in alcohol. The usual impurities to be found in carbonate of potash are *water, chloride and sulphate of potassa, silica, and earthy matters.* The amount of water is detected by the loss in weight the salt sustains, when heated to redness, the chloride by the *Silver Test*, and the sulphate by the *Baryta Test.* When the carbonate is supersaturated with muriatic acid and evaporated to dryness, and a residue is left on redissolving in water, then silica is present. Should the muriatic acid solution give a precipitate with carbonate of soda added in excess, then it contains some earthy substance. But probably hardly

any carbonate of potash is pure enough to withstand every one of these tests, and indeed for most purposes it is not necessary that it should be so pure; but for chemical analyses it must be *absolutely* pure, except in so far as regards the presence of water.

#### POTASSA, CHLORATE OF.

SYN. *Oxymuriate of Potassa.*

THIS salt occurs in tabular crystals of a pearly lustre, and is soluble in about sixteen times its weight of water at 60°; when the salt is heated, oxygen is evolved, and chloride of potassium remains behind. It detonates on burning charcoal, and a grain of this salt rubbed in a mortar with a grain of sulphur causes a violent explosion. It is not soluble in alcohol.

It is not subject to adulteration, but from faulty preparation may be contaminated with chloride of potassium. (See *Silver Test.*) A solution of chlorate of potassa is not affected by nitrate of silver.

#### POTASH, CHROMATE OF.

YELLOW or neutral chromate of potash does not probably occur at the present time in commerce, it having been replaced by the bichromate of potash.

*Sulphate of potash* was an impurity often found in chromate of potassa. A moderately concentrated solution of it, to which some dilute muriatic acid is added, would then give a copious precipitate with the baryta solutions. *Carbonate of potassa* might

also be present in the crude article. Its solution would then effervesce with a dilute acid. *Saltpetre* or *nitrite of potassa* might also be expected to be present. The common reactions for nitric acid, such as sulphuric acid with copper, the indigo solution, or green vitriol, will not show this in the presence of the chromate. The best way in this case to test for nitrogen-acids is to distil a solution of the salt cautiously with an excess of sulphuric acid. Nitric acid may be shown in the distilled liquor by the common tests.

#### POTASSA, IMPURE CARBONATE OF.

SYN. *Potash*; *Potashes*; *Pearlash*; *Lixivus Cinis*; *Potassæ Carbonas Impurus*.

COMMERCIAL POTASH occurs in lumps of stony hardness, which are of a reddish or dark brown or grayish color, and have a strong caustic taste. When potash is calcined in a reverberatory furnace, it constitutes *pearlash*. This is white, or nearly so, and differs from *potash* in containing fewer organic impurities, and little or no free potassa uncombined with carbonic acid; consequently it is less caustic. Both forms of impure carbonate of potassa are contaminated with *chlorides*, *sulphates*, *silica*, *alumina*, and *oxides of iron and manganese*. They are said to be occasionally adulterated with *sand* and *common salt*. Their value can be determined by the method laid down in the article *Alkalimetry*. Crude European potash contains from 60 to 80 per cent. of carbonated alkali. Dr. Linck found an American potash, brand-

ed by the New York inspector as first sort, to contain from 61 to 70 per cent. of alkali, and another, branded as second sort, from 55 to 60 per cent. In the manufacture of American potash, quicklime is added to the ashes, which is the cause of its causticity. This is done, probably, to get as much potassa as possible in the smallest bulk. European potash more nearly resembles pearlash. It contains no caustic potassa. By calcining potash in the gases of the kiln, they become carbonated by absorbing carbonic acid. *Saleratus* has a chemical constitution between pearlash and bicarbonate of potash. It is made from pearlash, and is only found in the American market.

#### POTASSA, NITRATE OF.

SYN. *Saltpetre*; *Nitre*; *Potassæ Nitras*.

NITRE crystallizes in prisms, and is soluble in about five parts of water at 60°. It has a sharp, cooling, saline taste, and is neutral to test-paper. It is insoluble in pure alcohol. It deflagrates when thrown upon burning coal. It fuses below red heat, and when cast into moulds it constitutes *sal prunelle*.

Nitre is almost wholly brought from Calcutta. That which occurs in dirty-colored crystals is called *crude* or *rough saltpetre*, and the white sort *refined saltpetre*.

Nitre is liable to contamination with *chlorides*, *sulphates*, *lime*, *earthy substances*, and *nitrate of soda*.

The following method has been used for testing nitre. Convert it into carbonate of potassa, by de-

flagrating it with charcoal, and then test it by the method given under *Alkalimetry*. But this method does not indicate the adulteration with nitrate of soda. The only really available method is to test for the impurities, and determine them. These, subtracted from the whole amount of nitre taken, will give the amount of pure nitre present.

The chlorides must be determined by the *Silver Test*, the sulphates by the *Baryta Test*, the earthy substances by their insolubility in water, and the lime by the aqueous solution giving a precipitate with oxalate of ammonia. If nitrate of soda is present, it will communicate a brilliant yellow flame to a solution of the nitre in common alcohol. To determine the amount of soda, the potassa must be either precipitated by perchloride of platinum, or the salts must be converted into sulphates, and then the amount of sulphuric acid determined, from which the amount of potassa and soda can be calculated. But whoever would use these methods must consult the different chemical works on quantitative analysis.

In the unadulterated more or less crude saltpetre, *chloride of potassium* and of *sodium* are the only impurities of importance. The quantity of chloride of silver which a given quantity of saltpetre will yield, is a sufficient guide, therefore, to judge of its purity. For the different purposes of chemical manufacture different amounts of these impurities are allowed, so that no general standard can be fixed in this respect. The more chloride of silver a solution of nitrate of silver yields, the worse the article

For the common applications of saltpetre it is sufficient if it is white and well crystallized.

In Sweden the quality of saltpetre is tested by fluxing it into a cake, and observing the radiation of its fracture.

#### POTASSA AND SODA, TARTRATE OF.

SYN. *Tartarized Soda; Potassio-tartrate of Soda; Rochelle Salt; Seignette Salt; Soda et Potassæ Tartras.*

ROCHELLE SALT occurs in very regular, large, transparent, colorless and odorless crystals, with a slightly bitterish taste. These crystals effloresce slightly on exposure to the air. Rochelle salt is soluble in five parts of cold water, but is much more soluble in warm water. It is insoluble in alcohol. Its solution does not affect blue or red litmus-paper. When occurring in well-defined crystals, this salt cannot easily be adulterated. When any insoluble residue is left on dissolving the salt in a small quantity of boiling water, it indicates an impurity, perhaps *cream of tartar* or *tartrate of lime*. A sulphate is pointed out by the *Baryta Test*, and a chloride by the *Silver Test*. After ignition, water should dissolve nothing but the pure carbonates of potassa and soda.

#### POTASSA, SULPHATE OF.

SYN. *Vitriolated Tartar; Sal de duobus; Potassæ Sulphas.*

THIS is a white, crystalline salt, inodorous, with a

slightly bitter, saline taste. From the hardness of its crystals, it is used for comminuting Dover powders, &c. It is soluble in water and insoluble in alcohol.

It is so cheap and little used in medicine or the arts, that it is not subject to adulteration. White and perfect crystals only should be dispensed for medicinal purposes.

It is said to be at times contaminated with *salt of zinc, copper, or iron*; but such impurities are easily recognized by the fact that the pure salt gives no precipitate with sulphide of ammonium. It should give no reaction with test-papers.

#### POTASSA, TARTRATE OF.

SYN. *Soluble Tartar; Potassæ Tartras.*

THIS is a white, crystalline salt, with a bitterish, saline taste, and is neutral to test-paper. It becomes moist in damp air, without, however, deliquescing. It is exceedingly soluble in water, but is nearly insoluble in alcohol. Exposed to red heat it blackens, and emits a perfectly characteristic odor. It is sometimes contaminated with *cream of tartar* or *carbonate of potassa*. In the former case it will redden blue litmus-paper, and in the latter it will restore the blue color to reddened litmus-paper. It is decomposed by ignition; the charred residue, when dissolved in water, should give the same reactions as pure carbonate of potassa.

## POTASSIUM, BROMIDE OF.

SYN. *Hydrobromate of Potassa*; *Potassii Bromidum*.

BROMIDE OF POTASSIUM crystallizes in rectangular prisms or in cubes; it is colorless and transparent, inodorous, and has an acrid, saline taste. It is very soluble in water, slightly so in alcohol. The solution is neutral to test-papers. This salt sometimes contains some *sulphate* or *chloride*. The former is detected by the *Baryta Test*. The following is the test given by the London college for the detection either of chloride of potassium or of sodium. "Ten grains decompose 14.28 grains of nitrate of silver, precipitating a yellow bromide of silver, which is little affected by nitric acid, but is redissolved by ammonia." If it precipitate more than the above quantity of nitrate of silver, it shows the presence of a chloride.

Bromide of potassium is distinguished from iodide of potassium by coloring starch-paste *yellow* instead of *blue*, when the bromide has been set free from the salt by the addition of a few drops of concentrated sulphuric acid.

## POTASSIUM, CYANIDE OF.

SYN. *Cyanuret of Potassium*; *Hydrocyanate of Potassa*; *Potassii Cyanidum*.

CYANIDE OF POTASSIUM, as usually prepared, occurs in white, opaque masses or fragments, has an odor of prussic acid, and an acrid, alkaline, and bitter taste. It is very soluble in water, but is hardly

soluble in strong alcohol. This salt seldom occurs perfectly pure, either on account of faulty preparation, or from not being completely excluded from the air, in which it rapidly undergoes decomposition. It should be perfectly white, should not effervesce with acids, nor blacken on the application of heat, and should be apparently dry.

#### POTASSIUM, FERRICYANIDE OF.

SYN. *Ferridcyanide of Potassium ; Red Prussiate of Potassa.*

THIS salt occurs in crystals of a magnificent red color, which are soluble in water. It is used in dyeing and as a chemical test to distinguish between protoxide and sesquioxide salts of iron, producing in solutions of the former a beautiful blue precipitate, called *Turnbull's blue*, and in solutions of the latter producing no precipitate, but imparting to it merely a darker color. For use, one part is dissolved in ten parts of water, and this solution should produce neither a *blue precipitate* nor a *blue tinge* with a solution of sesquichloride of iron.

#### POTASSIUM, FERROCYANIDE OF.

SYN. *Yellow Prussiate of Potassa ; Ferrocyanate of Potassa ; Ferrocyanuret of Potassium ; Potassii Ferrocyanuretum.*

THIS salt occurs in commerce in large pale-yellow, transparent, tabular crystals, without odor, and hav-

ing a sweetish-bitter, saline taste. It is soluble in four parts of temperate and two parts of boiling water, and completely insoluble in alcohol.

This salt is generally remarkably pure, though Persoz states "that it is sometimes, instead of being of a citron-yellow color, of a grayish-yellow color; and this tint must be attributed to the presence of a small quantity of protosulphuret of iron." A solution of it forms, with sesquichloride of iron, a deep-blue precipitate, and with sulphate of copper a dark purple-red precipitate.

#### POTASSIUM, IODIDE OF.

SYN. *Hydriodate of Potassa; Potassii Iodidum.*

IODIDE OF POTASSIUM is white and more or less translucent; it crystallizes in anhydrous cubes, has a pungent, saline taste, is somewhat deliquescent, and very soluble in water. 100 parts of water, at 64°, dissolve 143 parts of the salt, and it is soluble in about five times its weight of alcohol.

Its principal adulterations have been with *water*, *carbonate of potassa*, *chloride of potassium or sodium*, and *iodate of potassa*. The water is determined by drying at 212°.

Carbonate of potassa is recognized by its reddening turmeric-paper, by its rapid effervescence with acids, and by its insolubility in alcohol.

Iodate of potassa is detected by an aqueous solution of tartaric acid, which will disengage free iodine, the presence of which will turn starch-paste blue.

A chloride is determined by precipitating with nitrate of silver, adding an excess of ammonia, and adding to the clear filtrate pure nitric acid; should a curdy precipitate then ensue, a chloride is present.

The test for iodide of potassium is heating it with concentrated sulphuric acid, which evolves from it iodine in violet fumes, which condense in dark scales.

#### POTASSIUM, SULPHOCYANIDE OF.

SYN. *Sulphocyanuret of Potassium.*

THIS salt forms colorless, deliquescent, prismatic crystals, soluble in hot alcohol and in water. Sulphocyanide of potassium imparts to salts of sesquioxide of iron a deep blood-red color, which is a very delicate and characteristic reaction, and is employed as a test of these salts; and salts of sesquioxide of iron are conversely used to detect the presence of sulphocyanides.

#### PRUSSIC ACID.

SYN. *Hydrocyanic Acid; Acidum Hydrocyanicum.*

PURE or *anhydrous prussic acid* is a colorless liquid, of a strong, peculiar odor; its density is .705, at 44.6° F., and it boils at 80° F. It is miscible in water, alcohol, and ether. It being one of the deadliest poisons, it should never be tasted.

*Diluted or medicinal prussic acid*, which only is prescribed in medicine, should contain, according to the United States Pharmacopœia, two per cent. of anhydrous prussic acid; but that of the shops is apt

to vary in strength. It is colorless, and has the peculiar odor and taste of bitter almonds. This odor and taste is denied by many authorities, but the odor at least has always seemed to me like this.

The best test (*Prussic Acid Test*) for the presence of prussic acid, is to add to the solution liquid caustic potassa, and some drops of a solution of sulphate of iron, and then sufficient muriatic acid, when a precipitate of Prussian blue will take place.

If prussic acid gives a black precipitate with sulphuretted hydrogen, it contains either *mercury* or *lead*; but the usual impurities to search for are *sulphuric* and *muriatic acids*. The former is detected and determined by the *Baryta Test*, the latter by precipitating with nitrate of silver, and boiling with nitric acid, when the cyanide of silver will be decomposed and the silver will go into solution, while the chloride of silver will remain undissolved. (See *Muriatic Acid Test*.)

These foreign acids may also be detected "by dropping one or two crystals of *hydrargyro-iodocyanide of potassium* into the suspected acid. Should any foreign acid be present, a red precipitate will immediately be formed on them." Some of the cyanide of potassium will be decomposed, and the iodide of mercury, which had been kept in solution by it, will be precipitated.

A small quantity of a mineral acid is sometimes added, because it has been found that such an addition greatly retards the spontaneous decomposition of the prussic acid. Pure prussic acid hardly reddens litmus-paper at all. The mineral acid should be

added in such proportion as to produce a decided, but not a very strong, acid reaction.

Prussic acid undergoes some very complicated metamorphoses on keeping. It becomes of a brown color, and contains formic acid. One dram of the medicinal acid to which a few drops of ammonia have been added should not, on evaporation in a water-bath, leave more than one quarter of one per cent. of solid residue.

Again, to determine the quantity of pure prussic acid contained in medicinal prussic acid, take about twenty grains of it and precipitate with a solution of nitrate of silver; collect the precipitate, wash, dry, and weigh it. Each part of cyanide of silver is equivalent to 0.203 of pure prussic acid. Should the prussic acid contain muriatic acid, this must be determined as above, and the weight of chloride of silver deducted from that of the cyanide of silver.

#### PYROXYLIC SPIRIT.

SYN. *Wood-Spirit*; *Wood Naphtha*; *Hydrate of Oxide of Methyl*; *Spiritus Pyroxilicus*.

"THE wood-spirit or *pyroxylic spirit* of commerce is a heterogeneous mixture, containing, besides the hydrate of oxide of methyl, which forms the larger part of it, acetone and several other combustible liquids." (Graham.)

Pure wood-spirit is a volatile, colorless liquid, of a peculiar, penetrating, ethereal odor; *it burns with a pale flame like alcohol*, by which it may be readily distinguished from *pyroacetic spirit*. Its solvent pow-

er is very similar to that of alcohol. Its density is .798 at 68°, and it boils at 140°. It is a solvent for many resins.

### QUASSIA.

QUASSIA comes in cylindrical billets, which are rasped for medicinal purposes. It is a close, but light wood, of a pale-yellow color, inodorous, and of an intensely and *purely* bitter taste. This latter characteristic is sufficient to distinguish it from all other woods with which it may be adulterated.

### QUININE, SULPHATE OF.

SYN. *Disulphate, Subsulphate, or Basic Sulphate of Quinine; Quiniæ Sulphas.*

SULPHATE OF QUININE crystallizes in small, silky tufts, and in fine needles. It is inodorous, and very bitter. It is usually sold in the form of a loose mass of interlaced, filiform, silky crystals, of a snow-white color. *It does not affect test-paper.*

Dr. Linck has kindly furnished me with the following observations.

"The amount of water contained in the crystallized salt is stated variously by different authors. The *latest* experiments on the subject have been made by myself, and with a direct view of reconciling these different statements. Different samples of French, English, and American manufactured salt were tested; they all, without exception, gave four parts, or 8.79 per cent., of water of crystallization,

when dried at  $212^{\circ}$  F., and no further quantity of water could be expelled at a higher temperature without decomposing the substance itself. Other authors put the water much higher. According to my results, and the generally received constitution of the salt, the amount of sulphuric acid contained in it must be 9.80 per cent., which agrees perfectly with the amount found in all the samples which have come under my examination. This fact is of great importance in testing the purity of quinine, as will be seen below. On exposing the common salt to the atmosphere of a moderately warm room, half the water of crystallization is lost, and the amount of sulphuric acid rises to  $10\frac{1}{4}$  per cent. I have not, however, as yet, met in commerce any of the salt which had lost any water in this way, so that it appears that the manufacturers are well aware of, and guard against, this occurrence.

" Sulphate of quinine is nearly insoluble in cold water, but it is soluble in thirty times its weight of boiling water. Upon cooling, it crystallizes out of this solution almost entirely. If, therefore, upon triturating a few grains of the salt with some cold water and filtering, the clear solution should leave, after evaporation in a watch-glass, a considerable residue, an impurity must be present. The inexperienced manipulator will do well to make a trial with some pure salt precisely in the same manner, and compare the results, in order to be sure that his observation is correct.

" Upon adding a little dilute sulphuric or muriatic acid to the salt, it becomes soluble in a very small

quantity of the liquid. Such impurities as *starch*, *stearine*, and *boracic acid* will remain behind. *Salicine*, if present, will produce a blood-red coloration of the salt by moistening it with a little concentrated oil of vitriol.

" If very gently heated with a little weak potassa lye or milk of lime, the salt ought not to evolve any ammoniacal odor; if so, it is adulterated with a salt of *ammonia*. On exposure to heat, the salt should burn away without leaving any ashes; if a residue is left, an adulteration with *mineral substances* is shown. Their weight and qualitative composition may be ascertained, if desirable, by the usual chemical tests.

" If the salt under examination is well crystallized, perfectly neutral, has the right physical properties, and answers to the above qualitative tests, its purity may be inferred. If, however, any one of these indications should be doubtful, there is still another test, which is perfectly sure. This consists in determining the quantity of sulphuric acid in the neutral salt. If it is found to contain precisely its proper amount, namely 9.80 per cent., neither more nor less, the purity of the salt may be inferred.

" To determine this acid, from twenty-five to fifty grains of the salt are dissolved in a little weak muriatic acid, the solution diluted with pure water, and precipitated with chloride of barium. This precipitate of sulphate of baryta, collected and weighed under proper precautions, ought to amount to just 28.6 per cent. of the salt. Any less amount of precipitate will show the proportion of impurity. Any greater

amount will show the presence of some other sulphate. The only neutral sulphate leaving no residue on the application of heat, which is cheap enough to be used as an adulteration, is that of ammonia. Incombustible sulphates are so easily distinguished by incineration of the substance, that one would now hardly venture to adulterate quinine with them.

"If such an exceptional case should happen as the salt being overdried, the amount of sulphuric acid would be found larger, without any adulteration having been practised. In this case, twenty-five or fifty grains of the salt must be placed in a weighed watch-glass and heated in a water-bath, as long as it loses any weight (i. e. water). The loss of water (i. e. weight) will then be less than 8.8 per cent."

#### RHUBARB.

##### SYN. *Rheum.*

THE two principal varieties of rhubarb occurring in our shops are the *Russian* or *Turkey*, and the *Chinese* or *India* rhubarb. For a particular description of these, I must refer to the dispensatories. Good rhubarb is moderately dense, and is brittle, grits under the teeth owing to the presence of crystals of oxalate of lime, assumes a deep yellow color when moistened with the tongue, has a fresh appearance when broken, and is mottled with red, yellow, and white. Its powder is bright yellow, or slightly reddish-brown.

But besides these two species of rhubarb, *English*

and *Rhapontic* or *French rhubarb* sometimes occur in commerce. These are of very inferior value, and easily distinguished by physical appearance, taste, &c. from the *Turkey* and *Chinese rhubarb*. The *English rhubarb*, instead of being brittle, is spongy in texture, and neither this nor the *French* rhubarb grits under the teeth.

When rhubarb is very light, or very heavy, or worm-eaten, it should be regarded as inferior.

Rhubarb yields its active principle both to cold and boiling water, to proof spirit, alcohol, and ether.

The finer sorts of rhubarb are sometimes mixed with the inferior kinds. Rennie, in his Supplement to the *Pharmacopœias*, says: "The inferior sorts are artfully dressed up, by rasping, dyeing, perforating the pieces with holes, to make them resemble and pass for Russian rhubarb; and this is the sort which is usually hawked about the streets by Jews and Armenians." Neligan says that "powdered Turkey or East India rhubarb is very generally adulterated with *British rhubarb*; the fraud is difficult of detection, but the fresh powder of the finer sorts is always of a bright yellow color." The powder may also be colored with *turmeric*. Normandy states that the powdered rhubarb is often mixed with *gamboge*. "This sophistication may be readily detected by digesting a portion of the powder in ether, and pouring a few drops of the solution in water. If gamboge is present, a film of an opaque yellow color will be observed floating on the surface, which, on adding potash, is dissolved with an intensely red color."

## ROSIN.

SYN. *Colophony*; *Black Rosin*; *Fiddlers' Rosin*;  
*Colophonium*.

Rosin is the residuum left after the distillation of various species of turpentine; if the distillation is complete, the rosin is dark-colored; otherwise, or if boiled with water, it constitutes yellow rosin. Yellow rosin made from the black by boiling with water is less esteemed than that left after simple distillation. The two varieties of yellow rosin can be distinguished by drying at 212° F., when that prepared by boiling with water will return to the state of black rosin, while that not so prepared will remain yellow.

## SAFFLOWER.

SYN. *Bastard Saffron*; *Dyers' Saffron*; *Saffranon*;  
*Carthamus*.

SAFFLOWER is imported into this country from Calcutta, in small, flat, circular cakes, packed together in large bales, covered with gunny-cloth. It is also imported from the Mediterranean, and some is grown in this country and kept in the shops under the name of American saffron. Safflower has very much the appearance of saffron, but it has nothing of its taste or smell. "Safflower should be chosen in flakes of a bright pink color, and of a smell somewhat resembling tobacco. That which is in powder, dark-colored, or oily, ought to be rejected." (M'Culloch.)

Safflower contains two coloring matters, one yellow and soluble in water, the other red and insoluble in water and acids, but soluble in the alkaline carbonates. The latter constitutes the true coloring principle of safflower, and is called *carthamine*, or *carthamic acid*. Normandy says that good safflower should yield five per cent. of it. When carthamine is precipitated along with finely divided talc, it constitutes the cosmetic known as *rouge végétal*.

In order to ascertain the amount of carthamine contained in safflower, take a known weight of the latter, and wash it in several waters until these are no longer colored; then digest it in ten times its weight of cold water, in which one part of carbonate of potassa or of soda has been previously dissolved; this is then to be strained and expressed. Skeins of cotton must then be immersed in the liquor, and then tartaric or citric acid, or lemon-juice, must be added in excess. The red matter becomes fixed on the cotton, together with a little yellow coloring matter, which must be removed by washing. The skeins must now be immersed in a diluted solution of carbonate of potassa or of soda, when they will lose their color, and must be taken from the solution and expressed. The red coloring matter may be now thrown down by citric acid, or lemon-juice, collected on a filter, dried, and weighed.

The value of safflower may also be determined by the intensity of color produced by the above process on a known weight of skeins of cotton. In this experiment, comparison must be made with a standard safflower.

## SAFFRON.

SYN. *Crocus Sativus.*

SAFFRON consists of the stigmas and part of the styles of the crocus. It has a rich, deep, orange-red color, a penetrating, aromatic, and somewhat heavy odor, and a warm, pungent, bitterish taste. It tinges the saliva bright yellow, and when squeezed between the fingers, it colors them orange. It is slightly soluble in cold water, but much more soluble in warm water. It is soluble in alcohol and the oils, and is less soluble in ether. *Sulphuric acid changes its color first to blue and then to lilac.* Nitric acid colors it green.

There are two kinds found in commerce, the *hay* and the *cake saffron*. The former consists of the stigmas dried in their loose state; the latter, of the stigmas compressed into cakes. The *hay saffron* is the most esteemed. The *English saffron*, formerly so much prized, is said to have disappeared from our market. It is now principally imported from Sicily, France, and Spain.

Saffron, owing to its high price, is very liable to adulteration; for instance, with *water*, *safflower*, *marigolds*, and *fibres of dried beef*.

The latter adulteration is detected by the odor of burning hair being emitted, on igniting the article. The safflower and marigolds may be detected by their florets and petals, which are very different in appearance from the stigmas of saffron. These may be more easily recognized by soaking the article in

water, when the florets and petals will expand. "Old and dry saffron is '*freshened up*' by rubbing it between the hands, slightly oiled." (Cooley.)

Saffron is sometimes deprived of its coloring matter by infusion in water, and then dried again and put into the market. Such saffron has a pale red color, a fainter odor, and imparts a less yellow color to the saliva.

"The not staining the fingers, the making them oily, and its being of a whitish-yellow or blackish color, indicate that it is bad, or too old." (M'Culloch.)

In this country saffron is often used in domestic practice to keep cutaneous eruptions from "striking in."

#### SAGAPENUM.

THIS gum resin comes principally in semi-transparent masses of tears agglutinated together, of a yellowish color and tenacious consistence. It has a smell similar to that of assafœtida, but feebler, and a hot, nauseous, and bitter taste. An inferior sort is browner, softer, and in mass destitute of tears. It often contains visible impurities, such as *seeds*, &c. Sagapenum is almost entirely soluble in diluted alcohol. Cooley states that "the mass of the sagapenum sold to the retail dealer in London is factitious, and formed by mixing together assafœtida, galbanum, and other drugs in variable proportions."

## SANDARACH.

THIS resin comes in small, round, ovoid, or irregular tears, is of a pale-yellow color, is brittle under the teeth, without softening, and burns with a flame, emitting at the same time a strong aromatic odor. It is soluble in alcohol, ether, and hot spirit of turpentine. When pulverized, it constitutes *pounce*, which is rubbed on spots erased from paper to prevent ink from spreading.

## SARSAPARILLA.

SYN. *Sarsa.*

SARSAPARILLA ROOT should have a fresh appearance, and upon chewing should leave a distinct acrid impression in the fauces. Sarsaparilla is often poor in quality, either from age or damage, and is mixed with false and inferior roots; but the character of sarsaparilla root as given is the only sign to be depended on for its quality. I have lately noticed an importation of the *chumps* or rhizomas of the sarsaparilla, deprived of the roots; of course these should be rejected. They came in under the name of "sarsaparilla cuttings."

## SCAMMONY.

SYN. *Scammonium.*

PERHAPS there is no one article used in medicine so much adulterated as scammony, *pure* or *virgin*

*scammony* being very rare. The principal part, if not all, of the good scammony of commerce, comes from Smyrna, and is called *Aleppo scammony*, while an inferior sort is made in France, and is called *Smyrna scammony*, or more properly *Montpellier scammony*.

*Virgin scammony* is in amorphous masses, weighing from two ounces to half a pound each. It is a light, porous, friable, resinous substance, with a clear fracture, grayish externally, and of a dark greenish-black color internally; it has a peculiar cheesy odor, heightened by being breathed upon, and forms an emulsion readily with the saliva. It should contain at least 78 per cent. of resin.

But this variety of scammony is scarce, and hardly known in the market. Scammony commonly occurs in cakes, appearing as if moulded in large saucers. It is heavier than virgin scammony, more compact, and of a grayish-slate color; it has the same peculiar odor as the virgin scammony. Neligan states that he has frequently found in common scammony not more than from 28 to 35 per cent. of resin. Aleppo scammony is generally adulterated with *chalk* and *flour*, either separately or both together. The chalk is detected by effervescing with an acid, the flour by the *Iodine Test*. Besides these, scammony is undoubtedly adulterated with various other substances.

To determine the amount of resin in scammony, the following method of the Edinburgh Pharmacopœia may be resorted to. "Take any convenient quantity of scammony in fine powder; boil it in successive portions of proof spirit, till the spirit

ceases to dissolve any thing; filter; distil the liquid till little but water passes over. Then pour away the watery solution from the resin at the bottom; agitate the resin with successive portions of boiling water till it is well washed; and lastly, dry it at a temperature not above 240°."

The Montpellier scammony which I have seen is in smaller and thinner cakes than the Aleppo scammony, and is a very inferior-looking article. It should be rejected as worse than worthless.

#### SENNA.

THERE are several varieties of senna known in commerce, but the two principal ones are the *Alexandrian* and *India* senna. The former is the most esteemed, and has a shorter and more oval leaf than the latter. Alexandria senna has also a fresher color than the India, and is also more apt to be mixed with other leaves; but these spurious leaves can generally be distinguished by not having an uneven base, nor the same taste, as the true senna. India senna generally contains black or dark-colored leaves, which, if in too great a proportion to the healthy leaves, should cause it to be rejected. Neither should senna be too largely mixed with stalks or pods, nor too much broken.

Boiling water dissolves about one third of the weight of the leaves.

## SILVER, CYANIDE OF.

SYN. *Cyanuret of Silver; Argenti Cyanidum vel Cyanuretum.*

THIS is a heavy, white powder; it is insoluble in dilute nitric acid, but dissolves with decomposition in boiling nitric acid. It is also soluble in ammonia and in cyanide of potassium, and is precipitated again on the addition of an acid. When moistened with muriatic acid, it disengages prussic acid, which may be recognized by its odor. On ignition, it leaves pure silver behind.

## SILVER, NITRATE OF.

SYN. *Lunar Caustic; Lapis Infernalis; Argenti Nitrás.*

LUNAR CAUSTIC is a white salt, crystallizing in thin tables, and is soluble in its own weight of water; it has a metallic, caustic taste, and stains the skin violet or black. It is generally fused, and cast into little cylinders, by which it is rendered more convenient for escharotic purposes.

Crystallized nitrate of silver sometimes contains *free nitric acid*; for medicinal purposes it should then be purified by recrystallization.

Nitrate of silver is liable to be adulterated with *nitrate of potassa, lead, zinc, copper, black oxide of manganese, and plumbago*. The two latter may be detected by their insolubility in water, and the soluble impurities may be detected by precipitating the

silver completely with dilute muriatic acid, and filtering, when the clear filtrate should yield no residue on evaporation to dryness, nor should it be precipitated or discolored by sulphuretted hydrogen. If any residue is left after evaporation, the quantity may be estimated by drying and weighing.

There exists in commerce a lunar caustic, which the manufacturers call No. 2, and which they allow contains thirty per cent. of nitre. The sale of such an article in drug-stores is unjustifiable and criminal.

Fused nitrate of silver is also liable to contain *free silver*, from faulty preparation ; if present, it will be left, as a black powder, undissolved by water.

#### SILVER, OXIDE OF.

SYN. *Argenti Oxidum.*

OXIDE OF SILVER has a brown-olive color, is tasteless and inodorous, and is easily reduced to the metallic state by heat. When precipitated by muriatic acid from a solution of it in nitric acid, the filtrate should not leave any residue upon evaporation.

#### SMALT.

SYN. *Smaltz*; *Smalts*; *Azure Blue*; *Powder Blue*.

SMALT is prepared by melting together, in proper proportions, zaffre, white sand, and pure carbonate of potash, and afterwards reducing the mass to a very fine powder. It is a fine blue glass.

*Cobalt blue* or *Thenard blue* is prepared by calcining in a crucible three parts of phosphate of cobalt in

volume with twelve to fifteen parts of alumina. This mixture is transformed into a powder of a beautiful blue color.

If smalt or cobalt blue effervesces on the addition of an acid, it is probably adulterated with *chalk*. It should withstand the effect of heat and acids.

### SOAP.

SYN. *Sapo.*

SOAP is divided into two principal varieties, *hard* and *soft soap*. They are both made with oils or fats and an alkali, but the hard soap has *soda* for a base, while the base of soft soap is *potassa*. There are also innumerable varieties of both hard and soft soaps. As instances of the former we may mention Castile soap, Windsor soap, white bar-soap, yellow bar-soap, and the whole host of the toilet and perfumed soaps. Yellow bar-soap, besides fat and soda, also contains rosin. Among the soft soaps may be instanced common barrel-soap, and the shaving-creams. Soaps are made either from oils or fats, or from both combined. The Castile soap (Marseilles or Spanish soap), which is the most esteemed of the common soaps, is made from olive oil; Windsor soap is prepared from olive oil and ox-tallow, or suet; English curd soap is made with tallow, and American domestic soft barrel-soap is made with the refuse fat of the kitchen. Palm oil, cocoa-nut oil, almond oil, lard, &c., &c., are also used in the manufacture of soaps. Marbled soap is made by adding a minute proportion of green vitriol to white soap. But for fur-

ther particulars on the manufacture of soaps, I must refer to Ure's Dictionary of Arts, Manufactures, &c., to Knapp's Chemical Technology, &c., &c.

Every one knows the general properties of soap, its aspect, color, smell, taste, its cleansing power, &c., better than any words can describe them. Soap is soluble both in water and in alcohol; acids disturb its solution by separating the oily and fat acids from the potassa or soda.

Soap is sometimes adulterated with *lime*, *gypsum*, *oxide of iron*, &c., but these may all be detected and determined by their insolubility in pure alcohol.

The three essential constituents of soap are alkali, fat or oil, and water. Unless these exist in right proportions to each other, the soap may be regarded as at least not well manufactured, if not intentionally contaminated. The fraudulent manufacture most generally consists in the soap containing an excess of water, or in making it from a rank or nasty fat. This latter fraud can readily be detected by the disgusting odor of the soap.

Before giving the method of determining the amount of the different constituents of soap, I will give the following table, taken from Persoz, as a standard of comparison for any one who may wish to make a soap analysis.

*Hard Soap, with a Base of Soda.*

Soap.	Fat	Body.	Soda.	Water.	Analyst.
100 parts of White Marseilles,		50.2	4.6	45.2	Thenard.
" " Marbled "		64.0	6.0	30.0	"
" " " "		60.0	6.0	34.0	Darcet.
" " nine tenths of the fat tallow,	52	6	42		Ure.
" " Castile, Gr. 1.0705,	76.5	9	14.5		"
" " " " 0.9669,	75.2	10.2	14.3		"
" " White Soap, Glasgow,	50.0	6.4	33.6		"

*Soft Soap, with a Base of Potassa.*

Soap.	Fat Body.	Potassa.	Water.	Analyst.
100 parts of Green, . . . . .	44	9.5	46.5	Thenard.
" " "	44	9.5	46.5	Chevreul.
" " "	42	9.1	39.2	"
" " "	39	8.8	52	"
" " " or soft, made in London, . . . . .	46	8.5	46.5	Ure.
100 parts of Belgium green or soft,	36	7	57	"
" " Scotch " " "	47	8	45	"
" " " " "	34	9	57	"
" " rapeseed oil, soft,	51.66	10	38.34	"
" " olive oil,	48	10	42	"

" *To estimate the water*, weigh and cut into thin slices 70 or 80 grains of soap, taken both from the inside and outside of the mass, and dry it in a water-bath, or, what is better, an oil-bath, heated to 180° C. [356° F.]. When the desiccation is complete, the loss of weight will give the amount of water contained in the soap." (Persoz.)

" *To estimate the fat acids*, dissolve 4 to 6 drams of soap in water, and then add muriatic acid, which liberates the acids. Boil the whole in a weighed porcelain capsule, and let it stand until the fat acids congeal; then make a hole in the crust which they form above the liquid, decant, add a fresh portion of water, and again boil, and repeat the process so long as the wash-waters give a precipitate with nitrate of silver. Having decanted the water, dry the capsule containing the fat acids in a water-bath. The difference between the weights gives the quantity of the fat acid which existed in the soap." (Persoz.)

" To facilitate the solidification of the fat acids, and to have a quicker result, melt together with them, at the same time that these are separated by

the muriatic acid, a quantity of white wax, equal in weight to that of the soap taken. The process is then to be pursued as above, only the amount of the wax added must of course be subtracted.” (Persoz.)

Should the fat be in excess, the soap will not completely dissolve in water, but an oily matter will be seen to float on the surface. If soap contains free fat, it will also communicate a greasy stain to paper.

*To estimate the alkalies*, resort is had to *Alkalimetry*, which see. The same result may be had by decomposing one dram of soap by an excess of sulphuric acid, then filtering, and evaporating the liquor to dryness; calcine the residue, and the weight of the sulphate of potassa or soda will give, by calculation, the amount of potassa or soda.

“In order to determine whether soap contains an excess or not of base, take two pints of a saturated solution of *pure* chloride of sodium, and add to it a concentrated solution of three ounces of soap; then evaporate so as to expel as much water as was required to dissolve the soap, and leave it at rest. The soap, rendered insoluble by the salt, floats. The liquor may then be separated by decantation or filtration, and will give a strong alkaline reaction with test-paper. The amount of free alkali may be determined by an alkalimetical experiment.” (Persoz.)

Marbled soap cannot contain beyond thirty per cent. of water, as more water would prevent the marbling. “Hence marbled soap is especially es-

teemed by consumers," the marbling being a sign of a certain consistency of soap.

Soubeiran, in treating of *medicinal or almond soap*, says that "it should have only a feeble alkaline taste, or rather, according to M. Planche, it should not be colored gray when triturated with calomel; this is a proof that it contains no caustic alkali."

The following remarks on *saponification* are from Dr. Linck : —

"The fusibility and general physical character of the fat acids obtained from the soap will frequently allow of a judgment as to the nature of the fat which has been employed in making the soap; at least an inference may be drawn whether a hard and solid fat, or grease or oil, has been used. This, however, is only approximative. Sometimes the color and other impurities of the fat enter into these fat acids, and from them we may sometimes conclude what fat has been used. Rosin can easily be detected by boiling the fat acids with alcohol, and allowing the liquor to cool. Most of the rosin will remain dissolved, together with most of the *oleic acid* of the fat; the more rosin the residue contains after evaporation of the liquor, the more resinous it will be. If the soap is made from a very liquid fat, it will yield much *oleic acid*, which is much more soluble in cold alcohol than *margaric* and *stearic acids* (which give the solidity to the harder fats). In this case the rosin will be combined with it, giving it a certain stickiness. Soap from hard fats, treated in the same way, will afford a purer rosin from the alcoholic solution. These facts must be taken into consideration in making the tests.

"Fine sand is said to be added with advantage to soaps used for washing the hands, and it cannot then well be called an adulteration; *borax* and *anhydrous sulphate of soda* are also said to be used for some specific purposes. The first will remain behind on dissolving the soap in water or alcohol; the two latter can be found in solution, on decomposing the soap by an acid, and separating the fat by proper means."

#### SODA, ACETATE OF.

SYN. *Sodæ Acetas.*

THIS salt occurs in large, white prisms. It has a sharp, cooling, saline taste. Exposed to heat, it undergoes the watery fusion. It can bear higher heat than any other acetate without decomposition.

This salt is of importance, as being the principal source from which acetic acid, in a more or less concentrated and purified state, is obtained for several processes in the arts.

It is often contaminated with *sulphates* and *muriates*. The sulphates may be detected by the *Sulphuric Acid and Baryta Test*, and the chlorides by the *Silver and Muriatic Acid Test*. In making the silver test, pure diluted nitric acid must previously be added to decompose the acetate, as *acetate of silver* is very slightly soluble in water, and might be mistaken for chloride of silver. If, however, the amount of sulphates and chlorides is not very large, the article of course is not to be rejected for technical purposes, as, for instance, for making common acetic acid.

Chloride of platinum will give a yellow precipitate, if any *potassa salt* is present, but good crystals of acetate of soda would not be apt to contain any acetate of potassa.

*Tests.*—Drenched in sulphuric acid it gives off the fumes of vinegar. It also imparts to the flame of alcohol an intensely yellow color. For this purpose add a little of the salt to some alcohol in a spoon, and kindle it.

#### SODA, BICARBONATE OF.

SYN. *Sesquicarbonate of Soda; Soda Bicarbonas.*

THIS salt, as met with in the shops, is seldom a true bicarbonate. It is usually in the form of a white powder, but it sometimes occurs in small, indistinct crystals; it is inodorous, but has a very mild alkaline taste.

It is liable to adulteration with *carbonate of soda*, which may be tested for in the same way as carbonate of potassa is in *bicarbonate of potassa*, which see. The presence of a very small quantity of carbonate is also known by the more alkaline taste. Test also for other impurities as directed under the same head.

For medicinal purposes the soda should always be perfectly saturated with carbonic acid, when it will give a white, and not a brown, precipitate with corrosive sublimate, and no precipitate with a solution of Epsom salts.

For baking purposes this degree of saturation is not strictly required, nor perfect freedom from such

impurities as sulphate of soda. The baker or cook, on trying the article by baking on a small scale, will readily ascertain whether it answers the purpose or not.

Like bicarbonate of potassa, bicarbonate of soda is decomposed by heat, so that the solution should not be heated before testing with corrosive sublimate and Epsom salts.

#### SODA, BORATE OF.

SYN. *Borax; Biborate of Soda; Subborate of Soda; Tincal; Pounxa; Crysocolla; Soda Boras.*

TINCAL OR CRYSOCOLLA is borax in the crude state. It comes principally from India. "Tincal contains about one half its weight of pure borax, the rest appears to consist of a saponaceous combination of soda with a fat substance. This foreign substance is almost entirely found on the surface of the salt." (Berzelius.)

The purified salt, or that which is manufactured from boracic acid, is called *borax*. This occurs in white crystals, which are large, oblique, rhombic prisms, or flattened prisms of six or eight sides, commonly terminating by two or four converging planes. They contain 47.2 per cent. of water. They are translucent, and effloresce slowly in the air, causing the white, opaque appearance so commonly observed on the surface. Borax possesses a sweetish, feebly alkaline taste, and gives an alkaline reaction with test-paper. It is soluble in two parts of boiling, and in twelve parts of cold water. Heated, it at first

melts in its water of crystallization; then it intumesces, and is finally converted into a spongy mass, *anhydrous borax*; on increasing the heat, the mass melts and assumes a vitreous appearance, *glass of borax*.

A different variety of borax — *octahedral borax* — occurs, containing only 30.8 per cent. of water of crystallization. It is harder than common borax, and not efflorescent.

Crystals of borax are not apt to contain any foreign salts. It always occurs well crystallized in commerce. It is easily recognized by its physical properties, which are stated above. *Glauber salts* and *alum* are said to have been found in it, but such adulterations can readily be recognized by the eye. The most inexperienced observer would not be likely to overlook a crystal of Glauber salt in a lot of borax, and even alum could be distinguished by the greater clearness and brilliancy of its crystals, and the taste of such a suspicious crystal would be sufficiently confirmatory.

#### SODA, CARBONATE OF.

SYN. *Subcarbonate of Soda*; *Soda Crystals*; *Sodæ Carbonas*.

CARBONATE OF SODA is a white, efflorescent salt, crystallizing in rhombic octahedrons, truncated at the summit. It has a sharp, alkaline taste, is soluble in two parts of cold or one part of boiling water, and is insoluble in alcohol. It has an alkaline reaction, and effervesces with acids.

Pure carbonate of soda must be perfectly white. Its solution, when supersaturated with pure nitric acid, must not be rendered turbid by chloride of barium, nor by nitrate of silver, the former of which would indicate the presence of *sulphate of soda*, and the latter that of *common salt*, two very common impurities. When supersaturated with muriatic acid, and evaporated to dryness, the salt should leave no residue when redissolved in water, as this would show the presence of *silica*. Sulphide of ammonium must not alter its solution. Commercial crystallized soda almost always contains a sulphate and a muriate, and their total absence should by no means be required. Sometimes the crystals contain *caustic alkali*, and generally in this case some sulphuret. They will then be very caustic to the taste and touch, and will become moist on exposure to the air, instead of efflorescing. When a soda salt is inflamed in a capsule with alcohol, it burns with a fine yellow flame.

Under this head we will also speak of *soda-ash* or *soda-salts*, so called. This is an article of great importance in commerce and in the arts, and great quantities are imported into this country from Great Britain. It comes as a white or grayish, coarse powder, and has a caustic, alkaline taste. "The pure anhydrous carbonate of soda consists of 58.58 soda and 41.42 carbonic acid" (Graham);-but the soda-ash of commerce is never pure, and never contains over 54 per cent. of available alkali. *Tennant's* soda-ash generally contains 50 per cent. of alkali, and other soda-ashes contain as little as 38 per cent., and perhaps less.

To determine the amount of available soda in soda-ash, see *Alkalimetry*; but this article sometimes contains certain salts, as *hydrosulphite of soda* and *sulphuret of sodium*, which interfere with the alkalimetical operation. The former may be detected in solution by acidulating with muriatic acid, when a precipitate of sulphur will take place; the latter may be detected by adding to an aqueous solution a few drops of acetate of lead, and then acidulating with acetic acid, when a black precipitate will be formed. Earthy impurities are detected by remaining undissolved in water.

If the soda-ash contains hyposulphite of soda and sulphuret of sodium, it should be strongly heated before making the alkalimetical assay.

*Glassmakers'* soda-ash should be perfectly white.

#### SODA, HYPOSULPHITE OF.

THIS salt occurs in white crystals, which are very soluble in water. On adding an acid to a solution of the salt, the odor of sulphurous acid is given off, and sulphur is precipitated. Hyposulphite of soda should dissolve chloride of silver without *blackening* it (*sulphuret of sodium*).

#### SODA, IMPURE CARBONATE OF.

SYN. *Barilla*; *Commercial Carbonate of Soda*; *Sodæ Carbonas Venale*.

**BARILLA** is imported principally from Spain and the Canary Islands. It is obtained by burning dif-

ferent plants that grow on the sea-shore. The ashes so obtained are lixiviated, and the solution evaporated to dryness.

When of good quality, barilla is in hard, cellular, bluish-gray, dry masses, which become efflorescent on exposure to the air. It contains between 14 and 20 per cent. of carbonate of soda.

The method of determining its commercial value may be seen under the head of *Alkalimetry*.

#### SODA, NITRATE OF.

SYN. *Cubic Nitre*; *Chili Saltpetre*.

THIS salt occurs native, in rhombohedrons, and also in crystalline crusts and masses, of white, grayish, and brownish colors. It is soluble in water and alcohol, and is deliquescent. It is much used for making nitric acid, and as a manure. Normandy states that it generally contains, when not adulterated, over 95 per cent. of the salt. It may be tested in the same way as nitre. To distinguish it from nitre, place a little of it in burning alcohol, when it will communicate to the flame a brilliant yellow color, while nitrate of potassa gives a fine violet flame. The shape of the crystals alone, however, is sufficient to prevent its being mistaken for saltpetre. Sometimes it contains a trace of *iodine*. By adding a little starch paste to the concentrated solution, and then gradually small drops of chlorine-water, the blue coloration will appear, by which iodine is so characteristically indicated. Too much chlorine-water must not

be added at a time, as in excess it would destroy the blue color.

#### SODA, PHOSPHATE OF.

SYN. *Tribasic Phosphate of Soda; Rhombic Phosphate of Soda; Tasteless Purging Salts; Sal Mirabile Perlatum; Soda Phosphas.*

THIS salt is sold in colorless, oblique, rhombic prisms, has a cooling, saline, not disagreeable taste. It effloresces on exposure to the air. It dissolves in four times its weight of cold, and in twice its weight of boiling water, and is insoluble in alcohol. Its aqueous solution has a feebly alkaline reaction.

Phosphate of soda is not liable to any adulteration, but it is almost always contaminated with *carbonate of soda, a sulphate, or a chloride*. The first is detected by effervescing with an acid, the sulphate by the *Baryta Test*, and the chloride by the *Silver Test*.

Normandy says that it is sometimes contaminated with arsenic; if so, it may be detected by Marsh's test, or by giving a yellow precipitate by passing a stream of sulphuretted hydrogen through a solution of it, acidulated with muriatic acid. If a precipitate does not appear on standing twenty-four hours, no arsenic is present.

#### SODA, SULPHITE OF.

SYN. *Bleach Crystals; Antichlorine.*

THIS salt occurs in colorless, transparent crystals, without odor, but having a cooling, sharp, and bitter-

ish taste. It possesses the property of rendering harmless any chlorine remaining in cloth after the process of bleaching. Nitric acid, when added to it, gives off brownish-red fumes, and converts it into sulphate of soda.

#### SODA, SULPHATE OF.

SYN. *Glauber's Salt*; *Sodæ Sulphas*.

THIS is a white salt, occurring in acicular, or prismatic crystals, and has a saline, nauseating, and very bitter taste. It effloresces rapidly on exposure to the air, and is very soluble in water, but is insoluble in alcohol. When heated, it fuses in its water of crystallization. Its solution gives, with chloride of barium, a white precipitate, insoluble in muriatic acid. It should be neutral to test-paper.

#### SODIUM, CHLORIDE OF.

SYN. *Muriate of Soda*; *Hydrochlorate of Soda*;  
*Common Salt*; *Sodii Chloridum*.

COMMON SALT is white, crystallizes in cubes, is odorless, and has a peculiar saline taste. It is soluble in somewhat less than three times of its weight either of cold or boiling water. It is very soluble in weak alcohol, but sparingly soluble in absolute alcohol. It decrepitates on the application of heat.

Several varieties occur in commerce, such as *rock-salt*, *bay* or *sea salt*, *stoved salt*, *fishery salt*, &c. But all have the same chemical constitution.

All salt is more or less contaminated with *insoluble matter*, and *muriates and sulphates of lime and magnesia*. The sulphates give a precipitate with chloride of barium; lime, with oxalate of ammonia; and magnesia, with phosphate of soda and ammonia.

If any *nitrate* is present, (this would render it unfit for the manufacture of pure muriatic acid,) it may be detected by adding to the sample some sulphuric acid, and afterwards a crystal of green copperas, or a drop of sulphindigotic acid, when a black halo will form around the crystal, or the sulphindigotic acid will be decolorized. *Any carbonate* may be detected by the effervescence which will ensue on the addition of weak muriatic acid.

The tests for chloride of sodium are nitrate of silver, which gives a curdy precipitate soluble in ammonia, and the brilliant yellow flame produced by inflaming a solution of it in alcohol.

The following remarks are by Dr. Linck:—

“The dryness of salt is a point of much importance, because the water contained in it sometimes amounts to a large percentage, so that persons buying or using salt buy or use a smaller proportion than they suppose.

“For the salting of meat or fish, some kinds of salt have been found better than others, which difference is not accounted for by their chemical composition, as this may be nearly identical. Sea-salt, such as is produced by the spontaneous evaporation of sea-water in hot climates, is generally preferred to all others. It has been supposed that the small amount of Epsom salt, which is found in all sea-

salts, might be the beneficial principle. A much simpler explanation, however, may be offered, which as yet has not been tested by experiment.

"It seems to be the general custom amongst those who cure provisions to use the salt by measure, instead of by weight. If all the different sorts of salt were of equal fineness and dryness, this would be well enough; but such not being the case, the proportion of salt actually used is uncertain. This irregularity might, perhaps, in a great measure, explain the bad results which have sometimes been obtained by the proscribed salt. We cannot say which of the actual impurities occurring in salt is the most injurious, no experiments by competent persons on this subject being known to us."

#### SPIRIT OF NITRIC ETHER.

SYN. *Spirit of Nitrous Ether; Sweet Spirit of Nitre; Nitre Drops; Spiritus Ætheris Nitrici.*

SWEET SPIRIT OF NITRE is a colorless fluid, has a fragrant, ethereal odor, and a pungent, ethereal, sweetish taste. It slightly reddens litmus, and does not effervesce with carbonate of soda. It is very subject to contamination and adulteration. The principal contaminating substances are *acetic and nitrogen acids, aldehyde*, and sometimes *prussic acid*. Water and alcohol are also very much employed to adulterate it. The acetic and nitrogen acids are detected by their reddening litmus-paper strongly and effervescing with the alkaline carbonates; prussic acid, by the *Prussic Acid Test*; and aldehyde, by the spirit of

nitric ether becoming brown on the addition of a solution of potassa. The article ought to have the specific gravity ordered by the pharmacopœia. If denser, water is present. The presence of too large a quantity of alcohol may be inferred by the liquid not possessing the right ethereal odor. This can be determined upon comparison with a good article. The alcohol used in the manufacture ought to be free of *fusel oil*.

Apothecaries ought to prepare this article themselves, because the (too cheap) article of commerce can seldom be relied upon as being of the requisite strength. The common article of commerce shows, by the density, that it is mixed with 33 per cent. of water.

#### STARCH.

Syn. *Amylum*.

STARCH is sometimes adulterated with *gypsum* and other *inorganic substances*, which may be determined by incineration. Its weight is often increased by containing an excessive amount of *water*. Starch when dried at  $212^{\circ}$  should not lose more than ten or twelve per cent. in weight.

The test for starch is iodine. (See *Iodine Test*.)

Starch of inferior quality is often mixed with finer starch. The whiteness of the article, and the nature of the paste which it forms, will show the sophistication. The microscope will effect the purpose still better, as different kinds of starch are composed of grains of different size and appearance.

## STORAX.

SYN. *Styrax.*

PURE storax, in tears, is extremely rare. It occurs in commerce in lumps, or cakes, *common* or *red storax*, which is mixed with *sawdust* and *other impurities*, or as an opaque, gray substance, *liquid storax*. Storax has a peculiar, agreeable odor, resembling that of vanilla or balsam of Peru. *Common* storax may be easily crumbled to a coarse powder. Neligan says, "No accurate account could be given of the adulterations of storax, so many different substances are sold under that name. The gray liquid storax is manifestly some compound of impure naphtha."

## STRONTIA, CARBONATE OF.

SYN. *Strontianite.*

STRONTIA occurs native, in small quantities, at various localities. If pure, it ought to be entirely soluble in nitric acid, and the solution should yield pure *nitrate of strontia*, which see. A little *clay* and more or less *carbonate of lime* are frequently contained in the native article.

## STRONTIA, NITRATE OF.

NITRATE OF STRONTIA ought to answer to all the tests given for nitrate of baryta, from which it can be distinguished well enough by its appearance and the red color which it imparts to the alcohol flame.

*Nitrate of lime* is the most common impurity, which, however, renders it unfit for the use of the pyrotechnist, owing to its great tendency to attract moisture from the air. This salt is detected by its complete solubility in absolute alcohol, nitrate of strontia being insoluble.

### STRONTIA, SULPHATE OF.

SYN. *Celestine.*

In its chemical characters, sulphate of strontia is identical with sulphate of baryta. Its specific gravity is 3.92 to 3.96. It occurs of various shades of color, as white, gray, bluish, or reddish. It has a vitreous lustre; its fracture is uneven, and that from some localities has a fibrous fracture.

### STRYCHNINE.

SYN. *Strychnia.*

STRYCHNINE usually occurs in the shops in the form of a gray, granular powder, but sometimes in perfectly white crystals. It is inodorous, but has an intensely bitter taste, this being communicated to water containing only an 80,000th part of it. Boiling water dissolves a 2500th part of it, and cold water a 6687th part. It is insoluble in absolute alcohol and ether, but soluble in ordinary alcohol and volatile oils.

“ If an extremely small quantity of strychnine be triturated with a little peroxide of lead, and then a drop of sulphuric acid containing a hundredth part of nitric acid be allowed to fall upon the mixture, there

will instantly be developed a magnificent blue color, which changes rapidly to violet, then gradually to red, and after some hours to a canary-yellow." (E. Marchand.)

Strychnia is hardly ever found pure, it usually containing *brucine* and *coloring matter*, and sometimes *inorganic impurities*. The latter are detected by being left as a residue after incineration, and brucine by being reddened by nitric acid.

#### SUCCINIC ACID.

SYN. *Acid of Amber*; *Acidum Succinicum*.

PURE succinic acid crystallizes in white, transparent prisms; it boils at 473° F., and can be sublimed at much lower temperatures. Cold water dissolves one fifth of its weight, and boiling water about one half. It is also soluble in alcohol, but scarcely at all in ether. It is not decomposed by dilute nitric acid. It is liable to adulteration with *tartaric acid*, *bisulphate* or *binoxalate of potassa*, and with *sal ammoniac*. Tartaric acid is detected as indicated under succinate of ammonia, sal ammoniac by giving off the odor of ammonia when heated with lime, and the inorganic salts by calcination; the bisulphate is also indicated by the *Baryta Test*, and the binoxalate by being converted into a carbonate on ignition, which will then effervesce with an acid.

Succinic acid is volatile, but these sophistications, with the exception of sal ammoniac, are not. Pure succinic acid does not char when heated, and crude acid only according to the amount of empyreumatic matter it contains.

## SUGAR.

SYN. *Saccharum.*

THE physical properties of sugar are so well known, that it is unnecessary to describe them. Sugar is very soluble in water and diluted spirits, is almost insoluble in absolute alcohol, and is entirely insoluble in ether.

In our market only two sorts of sugar are met with, the *cane* and the *maple sugar*, while in different parts of Europe two other sorts occur, the *beet* and *grape* or *starch-sugar*. Another variety, *sugar of milk*, is sometimes prepared for pharmaceutical purposes. But this article has little in common with the other sugars, except the name, and a sweetish taste. The cane, beet, and maple sugars have about the same sweetening power; the grape-sugar has much less, and the sugar of milk less than grape-sugar.

The principal impurities to be sought for in cane-sugar are *inorganic matter*, *water*, *molasses*, *farina*, and *grape* or *starch sugar*. The latter substance, though extensively added in Europe to cane-sugar, is not, I think, much, if at all, used for adulterating in this country. It may be detected by the action of concentrated sulphuric acid and of a solution of caustic potassa; the former blackens cane-sugar, but does not affect starch-sugar, while potassa darkens the color of starch-sugar, but does not alter that of cane-sugar. But the *Copper Test* is far more delicate. Add to the solution of sugar to be tested a few drops of a solution of blue vitriol, and then a quantity of potassa solution, and apply heat; if the

cane-sugar is pure, the liquor will remain blue, while, if it be adulterated with starch-sugar, it will assume a reddish-yellow color. Sugar of milk acts with the copper test in the same way as starch-sugar.

Inorganic matter is determined by incineration, farina by the *Iodine Test*, water by drying at 212°, and molasses by getting rid of it by recrystallization from alcohol, as also by the color and moisture of the article.

The *natural* impurities of sugar are *gum* and *tannin*; gum is detected by giving a white precipitate with diacetate of lead, and tannin by giving a black coloration or precipitate with persulphate of iron.

An experienced sugar-dealer easily judges of the value of sugar by the taste, smell, specific gravity, moisture, and general appearance.

The *value* of *molasses* may be determined by drying at 220°, and by the taste.

#### SULPHINDIGOTIC ACID.

SYN. *Solution of Indigo.*

To prepare this reagent, dissolve one part of pulverized indigo in seven parts of Nordhausen sulphuric acid, and filter. This solution must be filtered for use, and be diluted with enough water to give it a pale, transparent blue color.

#### SULPHUR.

SYN. *Brimstone.*

THE general properties of sulphur are too well known to need description in this place. It is in-

soluble in water, but soluble in alkaline solutions, alcohol, ether, and in the fixed and volatile oils.

Sulphur is derived from two sources, either from the native mineral, or from iron pyrites. The former is called *volcanic* or *native sulphur*, and the latter *pyritic sulphur*. Native sulphur comes principally from Sicily, but before exportation it is usually partly refined, and then comes to us in large blocks or lumps, called *crude sulphur*. Crude pyritic sulphur comes in *rolls* or *sticks*, and is chiefly prepared in Sweden and Germany. But roll, stick, or cane sulphur is also manufactured from crude native sulphur.

Besides these varieties of sulphur, three others are met with ; — *sublimed* or *flowers of sulphur*; *washed sulphur* (*sulphur lotum*), prepared by washing flowers of sulphur, until the wash-waters no longer react acid on blue litmus-paper; and *precipitated sulphur*, of a pale, grayish-white color.

Sicilian sulphur, even after the first distillation (crude sulphur), contains, according to Regnault, from ten to fifteen per cent. of earthy matters; but several authorities state that *good* Sicilian sulphur contains only three per cent. of impurities. These can easily be determined by the application of heat, which drives off the sulphur, and leaves the inorganic impurities behind, or by boiling in about ten parts of oil of turpentine, which dissolves only the sulphur.

Roll sulphur and flowers of sulphur are very liable to be contaminated with *arsenic*, especially when prepared from pyritic sulphur. It is said that volcanic sulphur never contains arsenic.

To detect arsenic, heat it with the strongest nitric acid, dilute the solution with water, neutralize with carbonate of soda, and acidulate with muriatic acid, and then pass through it a stream of sulphuretted hydrogen; should this give no precipitate, the sulphur is free from arsenic, whereas a yellow precipitate denotes its presence. (See *Arsenic*.) Arsenic may also be detecting by deflagrating with nitre. (See *Arsenical Tests* in the Appendix.)

*Washed sulphur* may contain *sulphurous* or *sulphuric acid*, but these are not present if the water with which it is washed does not redden blue litmus-paper.

*Precipitated sulphur* sometimes contains a very great amount, 60 per cent. or more, of *sulphate of lime*, owing to its being prepared with sulphuric, instead of muriatic, acid. The amount of this is determined by sublimation in a porcelain crucible, when the sulphate of lime remains behind. Like washed sulphur, precipitated sulphur should not affect litmus, or but slightly, if, as Soubeiran says, it contains some *sulphuretted hydrogen*. He also says, that medicinally "it appears to be much more active than the washed sulphur."

#### SULPHURIC ACID.

SYN. *Vitriolic Acid*; *Oil of Vitriol*; *Acidum Sulphuricum*.

THE common sulphuric acid of the shops—*concentrated, strong, or commercial sulphuric acid*—is a dense, oleaginous-looking liquid, transparent, color-

less when pure, but oftener more or less discolored from the presence of organic matter, which it chars; it has an escharotic, burning taste, is odorless, and does not emit fumes in the air. Its density should be 1.845; if less than this, it contains an excess of water (see *Acidimetry*); if the density is greater, it is probably sophisticated with inorganic salts, such as *sulphate of lead*. The United States Pharmacopœia directs that there be also kept in the shops *diluted sulphuric acid*, of the density 1.09.

In mixing strong sulphuric acid and water in a glass vessel, the precaution must be taken of adding the acid to the water, in a small stream, with constant stirring; for were the water added to the acid, such a degree of heat would be generated as in all probability to crack the vessel.

A *pure sulphuric acid* is also directed in the Edinburgh and Dublin Pharmacopœias, prepared by redistilling the commercial sulphuric acid. This also should have a density of 1.845.

Besides these varieties, another — *Nordhausen* or *fuming sulphuric acid* — is met with in commerce. It fumes on exposure to the air, is an oily liquid, generally of a brown color, and should have a specific gravity of 1.9. The term *oil of vitriol* strictly belongs to this acid.

The contaminations and adulterations to which sulphuric acid is subject are *organic matter*, *water*, *sulphate of lead*, *of potassa*, and *of iron*, *nitrous* or *nitric acid*, *muriatic acid*, *sulphurous acid*, *arsenic*, *tin*, and *selenium*.

It is important to distinguish most of these adulterations from each other, not only for purposes of medicine, but of the arts.

The amount of water is determined by the specific gravity, and by the neutralizing power of the acid with some alkali. (See *Acidimetry*.)

If the dark color of the acid is owing to the presence of organic matter, this is easily recognized by heating a portion of it in a test-tube, when the acid will become colorless.

The salts are determined by evaporating a portion in a porcelain crucible, and weighing the residue. And these may be distinguished from each other by very simple means. The sulphate of lead is precipitated by dilution with water after standing twenty-four hours. Sulphate of iron will give a blue precipitate with prussiate of potassa, and tin a brown one with sulphuretted hydrogen.

To discover *nitric* or *nitrous acid*, pour gently upon the sulphuric acid a few drops of a solution of green vitriol, when, if these contaminations are present, a brown or reddish color will be developed at the time of admixture. These acids also decolorize sulphindigotic acid.

Muriatic acid is determined by the *Silver Test*.

Sulphurous acid is revealed by adding some water and perfectly pure metallic zinc, and conducting the gas which escapes through a solution of acetate of lead, which will then be blackened, owing to the generation of sulphuretted hydrogen.

If the sulphuric acid contains arsenic, it will give a yellow precipitate with sulphuretted hydrogen, but

*Marsh's Test* is more delicate. Sulphuric acid, manufactured from iron pyrites, always contains arsenic, while that made from Sicilian sulphur is free from it.

Selenium is a contamination which mostly occurs in Nordhausen acid, and reveals itself by being deposited as a red powder.

Commercial sulphuric acid should not yield upon evaporation more than one quarter of one per cent. of residue.

#### SUMAC.

SUMAC is imported from Italy in the form of powder, and packed in bags. It comes also from other places. It is of a pale greenish color, has a strong odor, very much resembling that of tea, and a very astringent taste, without bitterness. It forms a dark precipitate with persalts of iron, and is much used in tanning and dyeing. It is said to be very frequently adulterated, but the quality of the article is best determined by trying it on a small scale, as it is used in practice.

#### TANNIN.

SYN. *Tannic Acid*; *Acidum Tannicum*.

As usually obtained, tannin is of a light-yellowish color, shining, and pulverulent. It is inodorous, and has a pure astringent taste, without bitterness. It is very soluble in water, much less so in alcohol, and sparingly soluble in ether. It reddens blue litmus-paper, and a solution of it strikes a deep blue-black color with sesquichloride of iron.

## TARTARIC ACID.

SYN. *Crystallized Acid of Tartar; Acidum Tar-taricum.*

TARTARIC ACID occurs in white, semi-transparent crystals, inodorous, and of a purely acid taste. The crystals are unalterable in the air; when heated they fuse; at a higher temperature the acid is decomposed, and finally entirely disappears, without leaving any residue, or but an insignificant amount. The incineration is best effected with the aid of red oxide of mercury. When thrown on to red-hot coals, it gives off the odor of burning sugar. It is very soluble in water, and is also soluble in alcohol. 20 grains of crystallized tartaric acid are saturated by 27 grains of crystallized bicarbonate of potassa. "It precipitates lime from its soluble vegetable salts, but not from its mineral salts, and this serves to distinguish it from oxalic acid." (Soubeiran.)

This acid is not liable to adulteration, but may contain *sulphuric acid*, *lime*, or *potassa*. Sulphuric acid is indicated by the *Baryta Test*; lime and potassa, by being left after incineration. "Good tartaric acid does not leave above a two-thousandth of its weight of carbonate of lime." (Christison.)

## TIN, PERCHLORIDE OF.

SYN. *Oxymuriate of Tin; Dyers' Physic.*

THERE are two varieties of this salt in use, one a clear solution of tin in nitromuriatic acid, the other a milky liquid, obtained by adding a certain amount of

nitric acid to an acid solution of salt of tin. Both have their particular uses in dye-houses. If either be treated with nitric acid, as described under *Protochloride of Tin*, the foreign metals may be detected.

*Pinksalt* is a combination of the perchloride of tin with sal ammoniac. The latter salt is almost always added in excess in the article of commerce. If treated with nitric acid, like the other preparations of tin, foreign metals may be detected. If the amount of oxide of tin which has been formed be determined, its weight will indicate the amount of tin present, which is the valuable ingredient.

The same is true of the other preparations of tin. 74.9 parts of binoxide of tin contain 58.9 parts of tin.

#### TIN, POWDER OF.

SYN. *Stanni Pulvis.*

CHRISTISON states that this powder is often adulterated with *powder of lead*. To detect this, treat the tin with strong nitric acid, which converts it into peroxide of tin; evaporate almost to dryness, then dilute with water, filter, and add to the clear liquor some sulphate of soda or of magnesia, or sulphuric acid, which will yield a white precipitate of sulphate of lead, if any lead is present.

#### TIN, PROTOCHLORIDE OF.

SYN. *Salt of Tin*; *Tin Crystals*; *Muriate of Tin*.

THIS salt occurs in white, deliquescent crystals, of

a very sharp and caustic taste. It dissolves in pure water, forming a turbid solution; if the water has previously been acidulated with muriatic acid, the solution is clear.

In order to test its purity, dissolve one or two drams of it in a little water, add half an ounce or an ounce of nitric acid, and evaporate to dryness over a water-bath. Lixiviate the residue with pure water and filter, evaporate again to a small bulk, add two or three drams of nitric acid, and dry again over the water-bath. Water should now dissolve little or no metallic substance. By the above process all the tin has been transformed into an insoluble binoxide of tin. Foreign metals, if present, remain in the form of nitrates in the aqueous solution, from which they will be precipitated in the form of sulphides; some (copper, lead, &c.), by adding hydrosulphuric acid; others (iron and zinc), by adding sulphide of ammonium.

*Liquid muriate of tin* is a strong solution of the foregoing salt. Its purity can be tested in the same way as that of the dry salt. It is sold of various strengths, which are indicated by the hydrometer.

## TURMERIC.

SYN. *Curcuma.*

FRESENIUS gives the following direction for preparing turmeric paper:—

“ One part of bruised turmeric-root is digested and heated with six parts of dilute spirit of wine, the tincture is filtered, and strips of fine paper are

dipped into it. Turmeric paper, when dry, must have a fine yellow color."

It serves to detect the alkalies, as these change its yellow color to reddish-brown. Turmeric paper should be cut into narrow slips, and be kept in well-stoppered vials.

### ULTRAMARINE.

SYN. *Lapis Lazuli*.

ANALYSIS gives as the constituents of the native as well as the artificial ultramarine, sulphur, soda, alumina, silica, and a trace of iron. The native article, and that of the more celebrated manufacturers, are distinguished by the great resistance they offer, without being decomposed, to atmospheric influences and heat. Some brands of the artificial article do not resist these influences as well, but from what cause is as yet unknown. Upon heating good ultramarine in a strong spirit-flame, no change of color will take place. Diluted muriatic acid decomposes it with evolution of sulphuretted hydrogen, having the odor of rotten eggs, and leaves gelatinous silica and sulphur undissolved. These tests serve to distinguish it from such pigments as *Prussian blue*, which blackens on heating, as *smalt*, which is altered neither by heat nor acids, and as *blue carbonate of copper*, which yields a blue solution in acids, easily recognized by immersing in it a clean iron surface, on which metallic copper will be deposited.

## VALERIANATES.

THE principal valerianates in use are those of *zinc*, *iron*, *quinine*, and *morphine*. There are no very general simple tests which can be relied on for the detection of adulterations. *Acetates drenched with a little oil of valerian* are sometimes said to be substituted for them. On decomposing from six to ten grains of some valerianate with a little moderately dilute sulphuric acid, the odor of acetic acid will become apparent. If the vapors are condensed in a distilling apparatus, the taste can also be recognized. There is also a case on record of the substitution of a *butyrate* for a valerianate. By decomposition with sulphuric acid the odor of butyric acid would probably be perceptible, and discernible from that of valerianic acid.

The solutions of most valerianates decompose on evaporation at a temperature above  $150^{\circ}$  or  $160^{\circ}$  F., some valerianic acid being lost. The valerianate of morphine of commerce, for instance, frequently contains free morphine from that cause. The salt will then not entirely dissolve in water, as it should if pure. It is said that valerianate of iron has been adulterated by *citrate of iron*, but the former is insoluble in water and soluble in alcohol, and the latter is soluble in water but insoluble in alcohol. The physical properties, solubility in water or alcohol, and the products of decomposition by sulphuric acid, will probably, in most cases, if not in all, be sufficient guides for the discovery of sophistications.

## VERATRINE.

SYN. *Veratria.*

PURE veratrine is a perfectly white powder, but it is often met with more or less colored. It has an intensely acrid taste, and a minute quantity applied to the inside of the nose causes violent sneezing. It is scarcely soluble in water, sparingly so in ether, and more so in alcohol. Sulphuric acid strikes with it an intense red color, and nitric acid forms with it a yellow solution. It should leave no residue on incineration.

## WATER.

SYN. *Aqua.*

THE composition and physical properties of this important substance are too well and generally known to require any description. It is met with as *pure, distilled, rain, spring, salt, and mineral water.* Water does not occur perfectly pure in nature, but contains in solution solid substances and gases. Rain-water, when collected with such precaution that no dust or other impurity is mixed with it, contains only a little *atmospheric air*, and an exceedingly small trace of *carbonate and nitrate of ammonia.* Both impurities are harmless for almost any practical application for which pure water is required. The air contained in it is far less than that contained in river or spring water, and to this deficiency the indifferent taste of rain-water is owing.

Common spring-water contains; besides the gases

(which are the same as those contained in atmospheric air), *solid substances* in solution. All the difference, as far as practical application is concerned, depends upon the differences of the solid substances contained in it. These substances are derived from the soil and rocks through which the water has flowed, and their quantity and quality are of course dependent upon the geological character of the surrounding country. Where the water finds much soluble matter, it will be strongly impregnated, forming the saline and mineral waters. If it meets with a soil from which carbonic acid or hydrosulphuric acid is emitted, these gases will be absorbed and found in the springs.

Common spring-water is divided into hard and soft water. Soft water is freer than hard water from salts, which are disagreeable to the taste, and injurious in application. These salts are the *chlorides of sodium, calcium, and magnesium*, as also the *sulphates of the oxides of these metals*, and the *super-carbonates of iron and lime*.

These *supercarbonates* on exposure to the air, or particularly on heating the water, lose the excess of carbonic acid which keeps them in solution, and their neutral carbonates are precipitated. The carbonate of iron also absorbs oxygen from the air, its protoxide becomes hydrated sesquioxide, which falls down as a brown mud, by which deposit ferruginous waters are easily recognized.

These precipitates are very bad for steam-boilers. They cause incrustations on the sides of the boiler, and make frequent cleaning necessary. Gypsum

(sulphate of lime) is also very troublesome. The more soluble salts are of less importance, unless they exist in very large quantities, since a very considerable amount of water can be evaporated in the boiler before these salts accumulate in sufficient quantity to form incrustations. It frequently occurs that manufacturing and other establishments using steam-power are to be located with regard to the quality of the water. Of course, no absolute and general standard of purity for water can be given. There are also *organic ingredients* found in water, especially in that of low and marshy regions. They are partly dissolved in it, and partly held in it by mechanical suspension. Such waters, on being kept in a warm place, will soon putrefy, and slimy and vegetable deposits will be formed. The microscope is the best means for detecting these ingredients. For this purpose, however, the water must first be allowed to remain in a warm place for several days, so as to allow of the formation of the vegetable products just alluded to. If a little solution of perchloride of gold is added to such water, it will form a brown coloration. In waters which abound in organic matter, this coloration will follow almost immediately; in others, after several hours standing.

The question, as it occurs in practice, is to ascertain the relative fitness of several waters which may be available in the same localities. Thus, in localities where very pure water does not occur, a larger amount of impurities must be allowed than in other localities. To examine water for the use of steam-

boilers, boil down one or two quarts in a small porcelain dish to one ounce, filter through a weighed filter, wash with a mixture of equal parts of alcohol and water, evaporate the filtrate, in a weighed porcelain or silver dish, over a water-bath to dryness. The filter, after being dried in the water-bath, is weighed, and also the porcelain or silver dish, after having been dried at  $225^{\circ}$  or  $240^{\circ}$  F., which is best done in an oil-bath. By the first operation we get an idea of the amount of the difficultly soluble substances in the water, and by the latter the amount of the easily soluble constituents. The filter is washed with dilute alcohol, as above, instead of water, to prevent the solution of the gypsum which may have been deposited during the evaporation. On comparing the results thus obtained with those from different waters, an inference may be drawn as to their relative value for supplying steam-boilers.

The fitness of water for the purpose of washing depends upon the amount of salts of lime and magnesia which it contains. These salts decompose soap, forming an insoluble soap of lime or magnesia, which is unavailable for washing. The quantitative determination of these bases will solve the question. There, is, however, an easier way open for comparison. Pour as many samples of water as are given for examination into wine-glasses of similar shape, and add to each a few drops of an alcoholic solution of soap, stirring it up with a glass rod. The more insoluble soap a water produces, the more turbid it will become, and if all the experiments have been made in

the same manner, the more or less the turbidity acquired by the solution, or the more or less the precipitate deposited on settling, the worse or the better the water will prove for washing.

For the use of dyeing establishments, there are many more requirements as to the character of the water. The water should be good for washing with soap. It should not deposit any impurities upon the goods which are washed in it, and should not affect the chemical nature of the mordant or dye-stuff. The first requirement has been already spoken of. Water which on exposure to the air deposits red oxide of iron, or organic matter, might soil the goods rinsed in it. Water containing iron will often affect dyes very seriously, producing dark or dirty shades in light patterns; even salts of lime and magnesia may sometimes interfere with the colors. Water containing sulphates or chlorides in large proportions will injure lead mordants, &c.

Complete analyses of the water under examination must be made, and these considered in regard to the application to which it is principally to be put. No general rules can therefore be given.

Good drinking-water should be agreeable to the taste, cool, and sparkling, and as free as possible from soluble impurities. Where persons or communities have a choice left in the source of this important beverage, both the palate and chemical analysis combined must serve as the guide.

As to the best material for pipe for conducting water and distributing it in houses, a few words will be said. The materials principally used for such

pipes are either wood, iron, or lead. The use of the two former materials has never yet been attended with any bad consequences to health, but the use of lead has often produced bad effects. The question, therefore, has arisen, In what cases is it safe or unsafe to conduct water through lead pipes? This question, however, cannot be answered very readily in a satisfactory manner, so as to embrace all cases which may occur. It is a fact, that the water of some wells conducted through lead pipes has produced in many cases lead diseases in those who have made daily use of it, and that the lead is corroded very visibly by such water, while in many other cases no such effects have been observed.

If we were in possession of a large series of good and reliable analyses of waters which dissolve lead, and such as do not dissolve it, we might attain to a knowledge of those substances which are the means of dissolving lead. Unfortunately, however, we do not possess any such data, and can therefore form no anterior judgment as to the behavior of a given water with lead, even if possessing its analysis.

Professor Horsford, in the particular instance of the introduction of the water from Cochituate Lake into the city of Boston, has solved the question in the following manner. He took for the basis of his observations the fact, that water has been served in lead pipes to families in the cities of Philadelphia and New York for a number of years, and that no cases of lead disease have occurred at those places. He therefore put samples of water from these cit-

ies in contact with a large amount of lead surface, making the circumstances under which the experiments were carried on in all of the cases as nearly alike as possible. Cochituate water, on analysis, showed less lead in solution than either of the two other waters, and he thus concluded that the former could be safely conveyed through lead pipe. Indeed, after two years' use of these pipes, no bad consequences have shown themselves.

This method of judging, however, is not generally applicable. In the first place, such standard waters cannot everywhere be had for comparison. They cannot be sent to a great distance without the risk of their losing some of the gases dissolved in them, or of the organic matter which they contain undergoing some changes which the experimenter cannot appreciate.

Another great difficulty with this method of examination is, that we are as yet unacquainted with all the influences which cause water to dissolve lead, and that therefore, in making these comparative trials, we may overlook one or the other of those unknown influences, without being aware of it, and thus arrive at uncertain results.

In almost all cases where water-works have been established with lead service-pipe, the introduction of the same has been tried practically, before the establishment of these extensive works, by individuals, and their experience has served as a starting-point; and this, in the present state of our knowledge on the subject, is the only safe method of proceeding. But since the introduction of water-works

into the different cities of this country will probably occur frequently for some time to come, it may not be uninteresting to state here our present knowledge on the subject in a condensed manner, thus showing the present extent of uncertainty in relation to it.

It is a fact long known, that, when fresh and bright lead filings are thrown into pure and fresh distilled water; there is no visible reaction. The lead remains bright and the water clear. The case is different, however, if this water is previously allowed to absorb atmospheric air. Then, as soon as the bright lead filings are thrown in, a white cloud is perceived in the water, consisting of hydrate and carbonate of protoxide of lead. If to the same water a small amount of almost any salt is added, the lead remains bright, and no action is visible. Almost any water in the state of purity in which it exists in nature will, when put in contact with a surface of bright (unoxidized) lead, dissolve some of the metal. But this action does not continue very long in many cases, and in all it becomes slower by degrees, until it reaches a certain stationary point; that is, when a white coat of a certain thickness has been formed on the surface of the metal, which consists of a mixture of hydrate and carbonate of protoxide of lead.

It has already been stated, that we have no data which tend to show what substances cause the continued solution of lead, and what proportion of these substances. Ammoniacal salts and certain chlorides and nitrates are believed to be the causes, but nothing definite is known of the matter as yet. The following example may serve to show the

difficulties attending the subject. It is well known that a moderately concentrated solution of common salt will act upon lead strongly, and dissolve a considerable portion of it. Chloride of barium of commerce, when dissolved in water, generally contains lead in considerable quantities, on account of its having been prepared in leaden vessels. Now, on the other hand, experiments made by Professor Horsford tend to show that small proportions of salt or chloride of calcium (a compound which is perfectly analogous to chloride of barium) diminish the solubility of lead in water. Thus it seems that, under different circumstances, the effect of the same substances may be entirely opposite.

Before closing this subject, it remains to be shown how the presence of lead in a given sample of water may be determined. The water must be delivered to the experimenter as fresh as possible in a bottle which must be quite filled, and should be agitated as little as possible during its transport. It is also desirable that it should undergo no unnecessary change of temperature. The examination may be made in the following manner.

Take from one to two quarts of the water, and add to it a few drops of nitric acid, so as to produce a slight acid reaction, fill with it a small porcelain or glass capsule, and evaporate over a water-bath, or by means of a small alcohol flame, filling up the capsule again, according as the evaporation takes place, until the whole amount of water is reduced to about one fluid ounce, and allow it to cool. During this evaporation a deposit may be formed of organic matter

in some cases, but lead may also be deposited in the form of a difficultly soluble lead compound, such as sulphate, phosphate, or chloride of lead, or compounds of oxide of lead with organic matter. Some of these lead compounds may stick to the walls of the vessel, so as to make it unsafe or inexpedient to transfer the residue at once into another vessel. It is, therefore, best to pass into it at once a stream of well-washed hydrosulphuric-acid gas. When the water is saturated with the gas, cover the vessel and set it aside for several hours. If after that time the liquid should not have retained a strong odor of hydrosulphuric acid, fresh gas must be passed in. The liquid is now transferred into a test-tube of white glass, the vessel rinsed with a little pure water, and the rinsings also added to the test-tube. If any lead was present, it will be seen swimming in the liquid in the shape of a black precipitate, which is allowed to settle and afterwards washed by decantation. It is finally boiled with a little nitric acid, the solution filtered, the excess of acid chased away by evaporation, and the filtrate again precipitated by hydrosulphuric acid. The lead precipitate, if any is produced, is then collected upon a weighed filter, washed, dried in the water-bath, and weighed. As a controlling test, the substance may be submitted to a qualitative examination, to prove that it is really lead, and nothing but lead. In practice, however, such an error could hardly occur, and therefore this last process is hardly necessary. If by the above process no lead precipitate is obtained, the absence of this metal is proved, and thus we may ascertain whether any

lead has been dissolved during the passage of water through a lead pipe.

*Mineral Waters.*—The description and the methods for analyzing them can hardly be brought within the limits of the present work, and for them the reader is referred to the larger standard works on analytical chemistry.

### WAX.

SYN. *Beeswax; Yellow Wax; Cera Flava.*  
*White Wax; Cera Alba.*

PURE *yellow wax* has a grayish-yellow color, a somewhat aromatic odor, scarcely any taste, a firm consistency, and is brittle, the fracture being granular.

*White wax* is in white cakes, is feebly translucent, inodorous, and insipid, and is harder and less soft to the touch than yellow wax.

Wax is insoluble in water, and in alcohol and ether when cold, but is soluble in boiling alcohol and ether, and in the fixed oils and in oil of turpentine. White wax fuses at  $155^{\circ}$ , while the melting point of yellow wax is about  $142^{\circ}$ .

Wax is very subject to adulteration, the substances employed being *rosin*, *Venice turpentine*, *suet*, *spermaceti*, *stearine*, *flour*, *starch*, *white-lead*, *effloresced sulphate of soda*, *barytes*, and other *earthy substances*.

If a sample of the wax is boiled with water, the white-lead and earthy matters will subside to the

bottom of the vessel, while the wax will float on the surface of the water on cooling. The sulphate of soda, or other soluble adulterations, will dissolve in the water, and may be determined by evaporating the solution to dryness. Starch and flour may be detected in the water by the *Iodine Test*. The rosin and Venice turpentine may be determined by their solubility in cold alcohol, which will leave them behind on being evaporated to dryness.

The detection of fatty substances is more difficult; but these emit a disagreeable odor when burned, and, if added in any considerable quantity, they impart to the wax greasiness and softness. According to Vogel, chloroform dissolves only twenty-five per cent. of wax, while fatty matters are completely soluble in it; therefore, if chloroform dissolves more than a quarter of its weight of wax, this has been adulterated. Suet may also be discovered by dry distillation, this, unlike wax, yielding sebacic acid, which is known by its giving a precipitate with a solution of acetate of lead. It is said that a tallow sophistication of only two per cent. may be discovered in this way.

Yellow wax, whether factitious or not, often has a fine yellow color given to it by boiling with turmeric. When this is the case, it will impart its color to water on boiling a portion of the wax in it.

## WOAD.

SYN. *Pastel*; *Glastum*; *Isatis Tinctoria*.

WOAD is imported from England in the form of a dark, moist mass, packed in tierces. “The best methods of conducting the fermentation and preparation of woad are still so very ill understood, that the goodness of any parcel of it can never be ascertained till it be actually used; so that it has the disadvantage of being purchased under the greatest uncertainty as to its true value.” — M’Culloch’s Commercial Dictionary.

## YELLOW BERRIES.

Two varieties of these berries are distinguished in commerce, the *French berries*, or *berries of Avignon*, and the *Persian berries*. The latter are larger than the French kind, and are more esteemed.

The berries are of a greenish color,—being gathered before maturity,—are marked externally with four grooves, and are divided internally into four compartments, each containing one seed. A decoction of one part of these berries in ten of water is of a yellow color, approaching to green, and has a vegetable odor and a slightly bitter taste.

## ZINC, ACETATE OF.

SYN. *Zinci Acetas*.

This salt occurs in small, white plates, of a pearly lustre, having a styptic, metallic taste. It is soluble

in water and alcohol. When sulphuric acid is added to it, it gives off the fumes of vinegar. Its aqueous solution yields, with ammonia, a white precipitate; which should *completely* dissolve in an excess of the precipitant. It should give no reactions with the solutions of salts of barium and silver.

#### ZINC, CARBONATE OF.

SYN. *Calamine*; *Impure Carbonate of Zinc*; *Calamina*; *Lapis Calaminaris*.

CALAMINE, as found in the shops, is in the form of a flesh-colored powder. That which has not been calcined previously to pulverization effervesces briskly with acids, while that which has been calcined—*prepared calamine*—effervesces but slightly.

When genuine, it is almost entirely soluble in sulphuric acid, is precipitated white by ammonia, and is soluble in an excess of it; but it is generally a very impure substance, containing *iron*, *copper*, and *earthy matters*. Mr. Brett has found it to contain from 75 to 87.5 per cent. of *sulphate of baryta*.

The latter and the earthy matters are insoluble in acids; the acid solution gives a brownish precipitate with ammonia when iron is present, and a blue coloration when it contains copper.

The United States Pharmacopœia orders the *precipitated carbonate of zinc* as a substitute for the above. It is a white powder.

## ZINC, CHLORIDE OF.

SYN. *Muriate of Zinc; Butter of Zinc; Zinci Chloridum.*

CHLORIDE OF ZINC is in solid, white pieces, of the softness of wax. It is fusible at  $212^{\circ}$ , and sublimes at a red heat. It is soluble in water, alcohol, and ether. Should it contain *iron*, its solution will give a blue precipitate with ferrocyanide of potassium, and if it contain *lead*, a black precipitate with sulphuretted hydrogen.

## ZINC, OXIDE OF.

SYN. *Flowers of Zinc; Zinc White; Pompholix; Philosopher's Wool; Nihil Album; Zinci Oxidum.*

OXIDE OF ZINC, when pure, is white, tasteless, and insoluble in water. If heated to low redness it acquires a yellow color, and on cooling again becomes white. It is soluble in the caustic alkalies, and in common diluted acids.

Oxide of zinc, mixed with drying oils, yields a white paint, and may be substituted for white-lead. It has one great advantage as a pigment over lead, that it is not blackened by sulphurous emanations in the air.

Its adulterations are said to be with *sulphate of zinc, oxide of iron, carbonate of lead, of lime, of magnesia, and of baryta, white clay, and starch.*

The presence of organic matter is detected by charring on being heated. To detect specially the

starch, see *Iodine Test*. The carbonates are shown by effervescing with acids, and all of the above carbonates, except carbonate of magnesia, are thrown down from their nitric acid solution by sulphuric acid, while the zinc continues in solution. The clay is insoluble in acid, and the acid solution gives a blue precipitate with prussiate of potassa, if iron is present. The presence of a sulphate is indicated by the *Baryta Test*. To detect arsenic, apply *Marsh's Test*.

Hydrosulphuric acid should give no precipitate in its solution in muriatic acid, and the precipitate given with sulphide of ammonium should be pure white.

#### ZINC, SULPHATE OF.

SYN. *White Vitriol*; *White Copperas*; *Zinci Sulphas*.

THIS salt is usually found in the shops in the form of granular or acicular crystals. It is a colorless salt, odorless, has a disagreeable, metallic, styptic taste, effloresces on exposure to air, and fuses when heated. It is soluble in two and a half parts of water, at 60°. According to Anthon, it is insoluble in alcohol of less density than .88, but one thousand parts of alcohol at .905 dissolve two parts of it. The acicular crystals bear a strong resemblance to Epsom salts, and have been administered by mistake instead of them. But they can readily be detected by the taste, which is very different.

White vitriol sometimes contains *copper*, but of-

tener iron. The solution of it should give, with sulphide of ammonia, a perfectly white precipitate, entirely soluble in excess. The ammonia would give a blue tinge to the solution if any copper were present, and a reddish precipitate if it contained iron.

Hydrosulphuric acid should cause no precipitate. The precipitate with sulphide of ammonium should be perfectly white.

## A P P E N D I X .



## A P P E N D I X.

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THE observations on chemical tests and testing, which follow, together with those which occur in the body of the work, will undoubtedly be sufficient for those for whom the book is designed.

Chemical tests may be divided into two sorts, *general* and *special*. The former are those which denote the group to which a substance belongs; the latter, those which denote the substance itself by a characteristic reaction.

### GENERAL TESTS.

*Organic* matter is distinguished from *inorganic* matter by being charred by heat.

The general tests for the *metals* when in solution are *sulphuretted hydrogen*, *sulphide of ammonium*, and *carbonate of ammonia*; the mode of testing by which, and the substances which they indicate, we shall proceed to speak of.

For the method of preparing sulphuretted hydrogen, see *Sulphuret of Iron*. It is generally most convenient to use the *solution* which is described under the same article.

If the solution to be tested by this reagent is not already acid, acidulate it with a few drops of *pure muriatic acid*, and add to it an excess of the solution of sulphuretted hydrogen,

or pass a stream of the gas through it. Should a precipitate take place, it must be either *antimony*, *arsenic*, *tin*, *gold*, *platinum*, *mercury*, *silver*, *lead*, *bismuth*, *copper*, or *cadmium*.\* This group is composed of two sub-groups, which may be separated from each other by means of sulphide of ammonium (see *Sulphuret of Iron* for its preparation), which dissolves the first five metals, but leaves the six latter undissolved. Should the clear liquor, separated by filtration from the sulphuretted hydrogen precipitate, leave no residue on evaporation, then the original liquor contained no other metals than those mentioned above.

Should sulphuretted hydrogen give no precipitate, none of these metals can be present in the solution, and there should now be added to it some *sulphide of ammonium*, after the solution has been carefully neutralized with ammonia, if acid, or with muriatic acid, if alkaline. Should this reagent give a precipitate, then the presence of either *,  *cobalt*, *manganese*, *iron*, *zinc*, *alumina*, or *chromium* is indicated. Should the clear liquor filtered off from the sulphide of ammonium precipitate leave no residue on evaporation and heating, then the original solution contained no other metal than those above mentioned.*

If the solution gives no precipitate with sulphuretted hydrogen or sulphide of ammonium, none of the above metals are present, and then a solution of chloride of ammonium, and afterwards carbonate of ammonia, must be added. If this gives a precipitate, *baryta*, *strontia*, or *lime* must be present; but if it does not give a precipitate, and yet a residue is left on evaporating and heating, *magnesia*, *potassa*, or *soda* must be present.

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\* There are some other metals thrown down by this reagent, but they are of too rare occurrence to be alluded to in this work. Indeed, the rare metals will not be alluded to at all under the head of testing.

Having separated the metals into groups, the next step to be taken is to detect the particular metal or metals that are in the solution. This is done by special and confirmatory tests given in this Appendix, and also by tests given in the different articles in the body of the work.

Though the acids are also divided into groups by general tests, we shall not describe them, as special tests are sufficient for detecting those which are alluded to in this work.

#### BLUE AND RED LITMUS-PAPER.

For the method of preparing, see *Litmus*. They are used for distinguishing an acid compound from a basic compound. Blue litmus-paper is reddened by a free acid and by most neutral salts of metallic oxides, and *red* litmus-paper has its blue color restored by an alkali, alkaline earths, carbonates, &c. If neither is affected by a solution, this is neutral.

#### TURMERIC PAPER.

See *Turmeric* for the method of preparing. It is not affected by acid solutions, but is turned reddish by alkalies.

### SPECIAL TESTS.

#### SULPHURETTED HYDROGEN.

This reagent is used, not only as a general, but also as a special test. Though with most of its metals it gives a black precipitate, yet it serves to indicate antimony by an orange-colored precipitate, and arsenic and tin by precipitates of peculiar yellow shades, these metals all being soluble in sulphide of ammonium; and when it gives a yellow precipitate which is insoluble in sulphide of ammonium, the presence of cadmium is certain.

## SULPHIDE OF AMMONIUM.

In one instance only can this reagent be applied as a special test, and that is for manganese. When it gives a fine, flesh-colored precipitate, this metal is certainly indicated. But it must be recollect that in this case, as in others, that these characteristic tests are in a great majority of cases obscured by the presence of other substances, and that though a perfectly characteristic test assures us of the presence of a certain body, the absence or obscuration of that test by no means indicates its absence. If a substance is *pure, unless it be a compound salt*, the characteristic test, as a general rule, should always be produced.

## AMMONIA TEST.

The salts of ammonia are recognized by heating them with caustic potassa, or air-slaked lime, when the ammonia will be set free, and can be recognized by its pungent odor, and by forming a white vapor when a glass rod moistened with diluted muriatic acid is held over it.

## OXALIC ACID AND LIME TEST.

Oxalic acid and oxalate of ammonia form a white precipitate with solutions of lime and its salts, which are soluble in mineral acids, but insoluble in acetic acid. To detect the oxalates, use chloride of calcium, or sulphate of lime. Sulphate of lime, being somewhat soluble in water, distinguishes lime salts from those of baryta and strontia.

## BARYTA AND SULPHURIC ACID TEST.

Sulphuric acid or soluble sulphates form with baryta or its soluble salts a white precipitate insoluble in muriatic and nitric acid. The method of distinguishing baryta from strontia salts is found under *Nitrate of Strontia*. When a baryta

solution gives a white precipitate insoluble in acids, it is an absolutely certain test for sulphuric acid and its salts.

#### SILVER AND MURIATIC ACID TEST.

When a solution of nitrate of silver is added to muriatic acid or to a muriate, a white, curdy precipitate is produced, insoluble in nitric acid, and readily soluble in ammonia; and, *vice versa*, muriatic acid is a test for silver salts in solution.

#### POTASSA AND TARTARIC ACID TEST.

Tartaric acid added in excess to a neutral potassa salt gives a white crystalline precipitate, soluble in strong mineral acids and alkaline liquids. If the liquid is considerably diluted, the precipitate will not appear till after some time, or not at all. The ammoniacal salts give the same reaction, and consequently the absence of this must be previously determined by the *Ammonia Test*. If found to be present, it must be driven off by heat before testing for potassa.

#### PRUSSIATE TEST FOR IRON.

Add to the neutral solution which is to be tested some ferrocyanide of potassium; this will strike with salts of sesquioxide of iron a beautiful blue precipitate, Prussian blue; the presence of no other body, except copper salts, will prevent this color from being revealed. The salts of protoxide of iron give a pale precipitate, which turns blue rapidly on exposure to the air.

#### COPPER TESTS.

When copper is in solution, ammonia forms at first a green precipitate, which dissolves in an excess of it with a fine azure-blue color. A bright iron plate, or knife-blade, when immersed in a neutral or only very slightly acid solution of copper, becomes covered with a copper-red coating.

## MAGNESIA AND PHOSPHORIC ACID TEST.

If the solution under examination contains nothing precipitable by sulphuretted hydrogen, sulphide of ammonium, or carbonate of ammonia, in presence of chloride of ammonium, it may be tested reciprocally for magnesia salts or phosphates. If magnesia is to be sought for, add to the solution ammonia and a solution of phosphate of soda ; or if phosphoric acid is the body sought, add to it ammonia and a solution of Epsom salts ; in both cases a white precipitate is produced.

## IODINE AND STARCH TEST.

Iodine is detected by adding dilute starch paste, which has been boiled and cooled, to the solution of the iodine, and then carefully adding some strong sulphuric acid, when a blue compound is produced. Starch is detected in a substance by boiling it in water and allowing it to cool, and then adding some iodide of potassium and sulphuric acid, or some tincture of iodine, when the same blue compound will be produced.

## MARSH'S ARSENICAL TEST.

Introduce some zinc and water into a half-pint or pint flask, and fit to it, by means of a perforated cork, a funnel tube, and a Bohemian glass tube, bent at a right angle, and drawn out to a fine jet. Pour in through the funnel-tube some dilute sulphuric acid, until a lively evolution of hydrogen gas ensues. Envelop the flask in a towel to prevent the glass from flying, in case of an explosion, and then, after a few moments, kindle the gas issuing from the jet. Then depress a cold white porcelain surface into the flame, in order to ascertain the absence of arsenic in the materials used for generating the gas ; if the surface remains white, these ma-

terials do not contain arsenic, and are fit for use in this experiment. The flame must now be extinguished, and the solution suspected of containing arsenic, which must be acid, is added through the funnel-tube, and the gas again kindled, and the porcelain surface again depressed into the flame. Should the solution contain a trace of an oxygen compound of arsenic, gray metallic mirrors will form on the porcelain, which are soluble in boiling nitric acid. Antimony also forms a mirror, and when this is known also to be present, the operation must be conducted as described under *Ar-senic Test in Presence of Antimony*.

#### ARSENIC TEST IN THE PRESENCE OF ANTIMONY.

To detect arsenic in the presence of antimony, precipitate the solution with sulphuretted hydrogen. The precipitate, after being well dried, is to be deflagrated and fused in a porcelain crucible, with nitre and carbonate of soda, and after cooling is to be treated with cold water. Neutralize the aqueous solution with pure nitric acid, and filter. The filtrate will contain the arsenic, if any was present, and this will be shown by *Marsh's Test*, and by its giving a yellow precipitate with sulphuretted hydrogen, and in a perfectly neutral solution a reddish-brown precipitate with nitrate of silver.

#### NITRIC ACID TESTS.

If free nitric acid, or a nitrate to which a few drops of sulphuric acid is added, is poured into a solution of indigo, it will destroy its blue color.

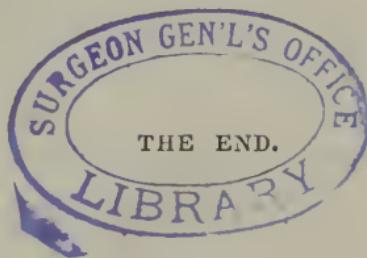
Free nitric acid, or a nitrate to which sulphuric acid has been added, gives off red fumes of a disagreeable odor, when digested with copper turnings, and changes the green color of a crystal of sulphate of iron to brown.

Nitric acid and the nitrates are not precipitated by any reagent.

The nitrates deflagrate on being thrown on to red-hot charcoal.

TESTS FOR ORGANIC MATTER.

Organic substances, with the exception of ammonia, carbonic acid, oxalic acid, and a few others, are charred by incineration. Azotized matter, with the exception of ammonia and some cyanides, is also charred, and is distinguished from non-azotized organic matter, by giving off ammonia when heated with caustic potassa or air-slaked lime. (See *Ammonia Test.*) Animal organic matter, when burnt, gives off the odor of burning hair.







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